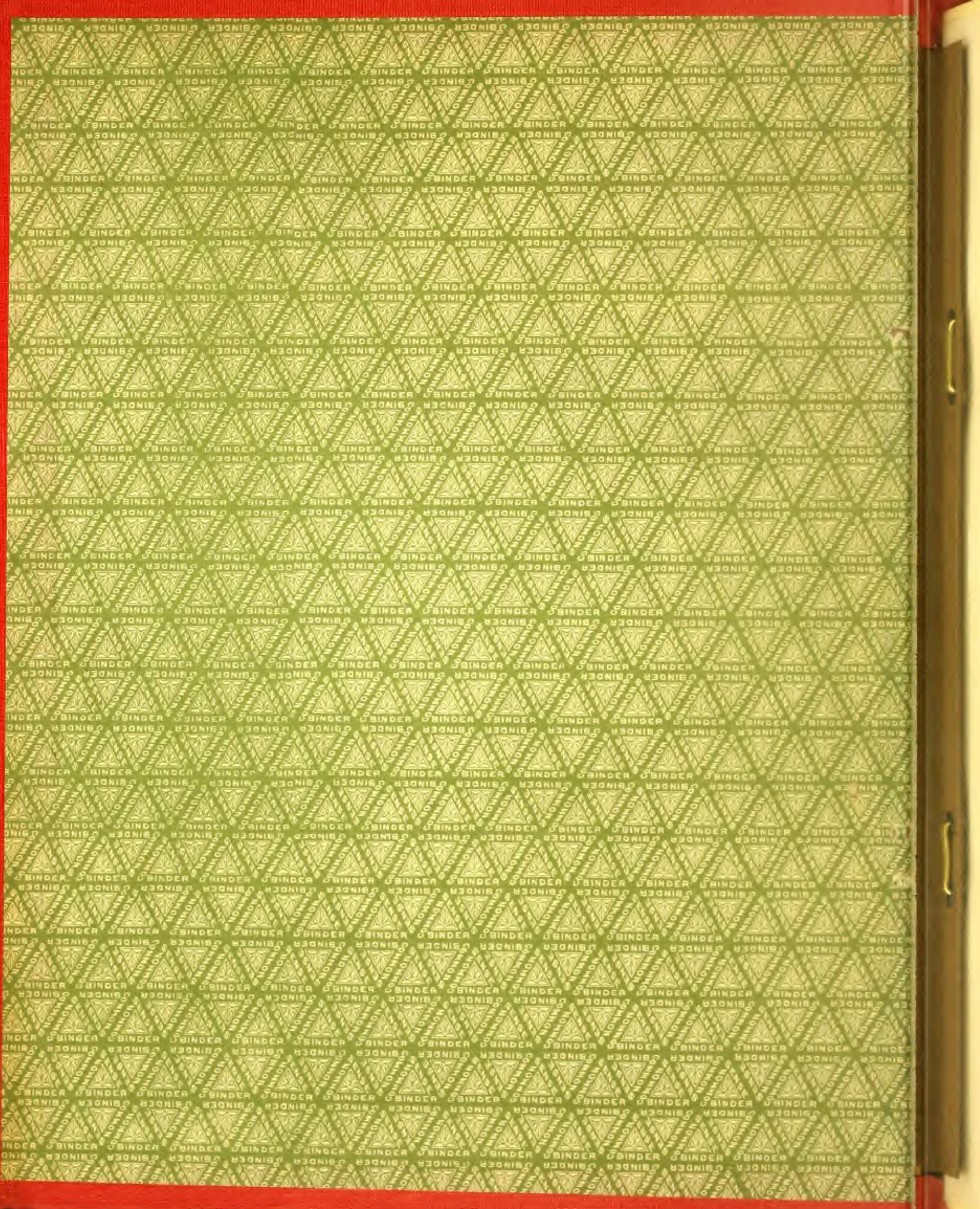


# BRISTOL'S RECORDING INSTRUMENTS

MANUFACTURED BY  
**THE BRISTOL COMPANY**  
WATERBURY, CONN., U. S. A.









PRESSURE AND VACUUM

LIQUID LEVEL

TEMPERATURE







LIQUID LEVEL

TEMPERATURE

PRECIPITATION



TH

Boston

"CATAL



# THE BRISTOL COMPANY

## WATERBURY, CONN., U. S. A.

BRANCH OFFICES

Boston New York Philadelphia Birmingham Pittsburgh Detroit Chicago St. Louis San Francisco

\*CATALOG

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The Bristol Company

NO. 1007

### BRISTOL'S RECORDING GAUGES FOR PRESSURE AND VACUUM

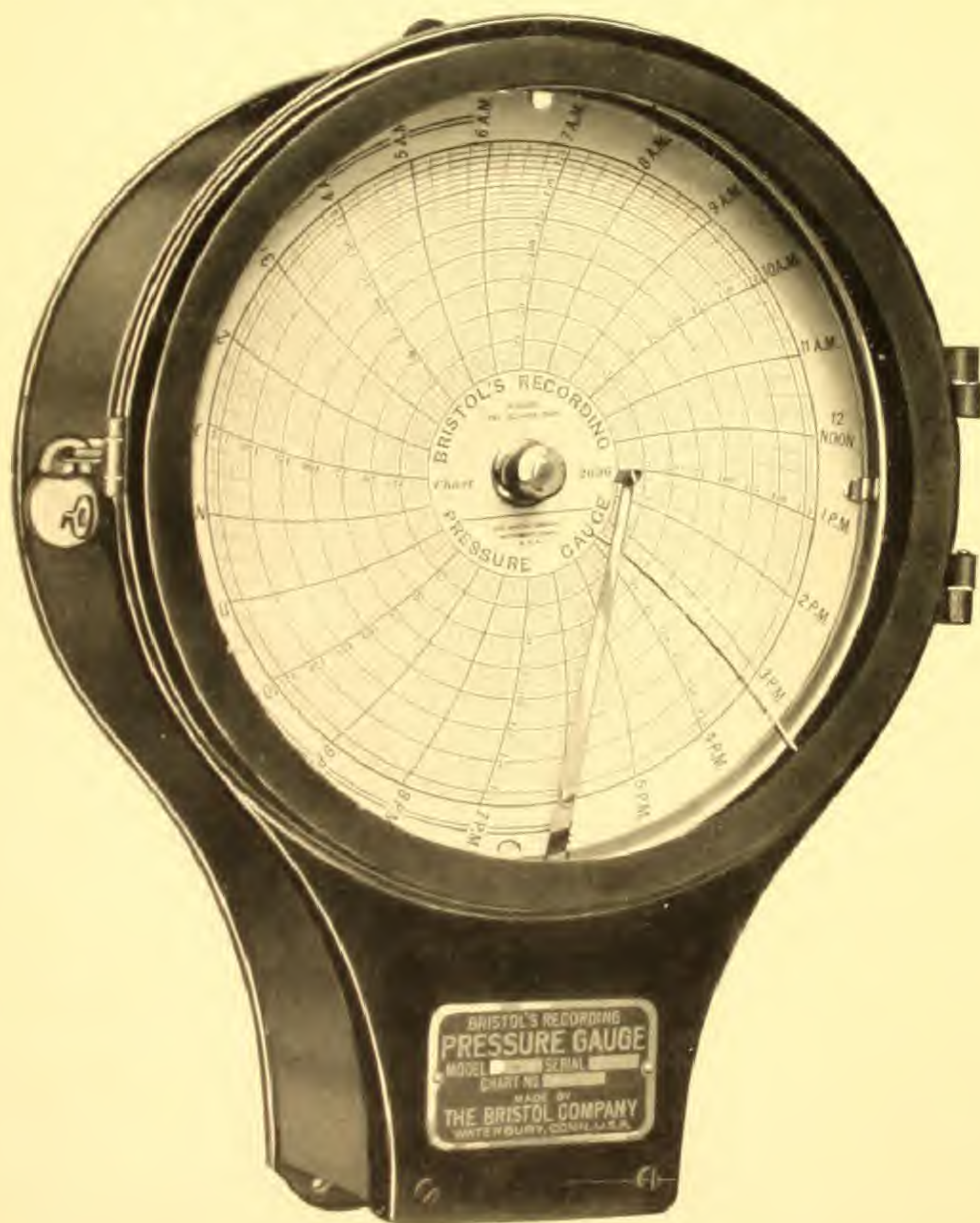


Fig. 1854

\*Catalog No. 1007 supersedes No. 1006

TEMPERATURE

PERCENT

WATERBURY, CONN.



8-Inch Diameter  
Pounds per  
Atmosphere  
Ounces per  
Inches Head  
Inches Head  
Mercury V  
Inches Head  
sure

Clock Movement  
Combination  
Element  
Connection:  
  
Details for  
Vacuum  
Dimensions:  
Drilling Dime

## Electric Time

Fixative . . . .  
Flexible Conn  
Fountain Pen

Ink.....  
Introduction

List Price:  
Vacuum C  
Liquid Level C  
Long Distan  
Electric

Method of Ma  
Micrometer A  
Model 11 Orig  
sure Gauge  
Model 12 Po  
Gauge

Model 40 Inven-  
Model 41 Mo-  
Model 45 Wa-  
Model 47 Eccen-  
Model 61 Rou-



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## INTRODUCTION

As a result of more than thirty years' experience in designing and manufacturing recording instruments, The Bristol Company now offers the most complete line of recording pressure and vacuum gauges that has ever been placed on the market. More than seventy-five thousand of these instruments have been sold.

### Range

All ranges, from full vacuum to 12,000 pounds pressure per square inch, can be taken care of by Bristol's Recording Pressure and Vacuum Gauges. The great variety of charts listed in this catalog adapt the gauges to practically every application where pressure of liquids, gases, steam, or air are required to be measured.

### Utility of Recording Gauges

The Recording Gauge located where the Operator can see it shows the pressure or vacuum as it is now, what it has been, and the direction in which it is leading. With such a record the attendant is able to control conditions to a high degree of efficiency, and is at all times conscious of the fact that these records are open for inspection by the management. The continuous records obtained by Bristol's Recording Gauges give the Superintendent or manager information on operating conditions for every hour of the day and night, thus assisting them in securing and maintaining uniformly efficient operating results. The chart records may also be filed away for future reference and comparison.

### Simplicity

The most simple equipment which will do the work is the most practical for that work, because it is the easiest to maintain in operation, is the principle on which Bristol's Recording Instruments have been designed. On page 8 the interior construction of the high range gauge is shown. It will be noted that the recording pen arm is attached directly to the pressure element without employing gears, links, levers, ratchets, multiplying devices, or other complicated mechanisms. For some ranges a box type of diaphragm element is furnished (see page 10), which will stand a very heavy overload and is dead-beat. Bristol's Recording Gauges are simple and robust in construction, and

for these reasons have proved to be well adapted for use under ordinary shop conditions and durable in long continued service.

### Partial List of Applications

Steam Boiler Pressure, Exhaust Pressure, Steam Pressure on Heating Mains, Steam Pressure for Dry Kilns, Vulcanizers, Pulp Digesters, Brick Dryers, Air Compressors, Pressure and Vacuum in Ammonia Lines, Vacuum Gauges for Condensers and Chimney Draft, City Water for Fire Protection, Head of Water in Reservoirs, Stand-pipes, etc., Natural Gas Pressure, Gas Pressure in Coal Gas and Water Gas, and By-Product Coke Oven Works, Top Gas and Blast Pressure at Blast Furnaces, Mine Ventilating Fans, Impregnating Tanks, Pressure of Oil on Step-Bearings, Air Pressure on Filter Presses, etc., etc.

### Recording Liquid Level Gauges

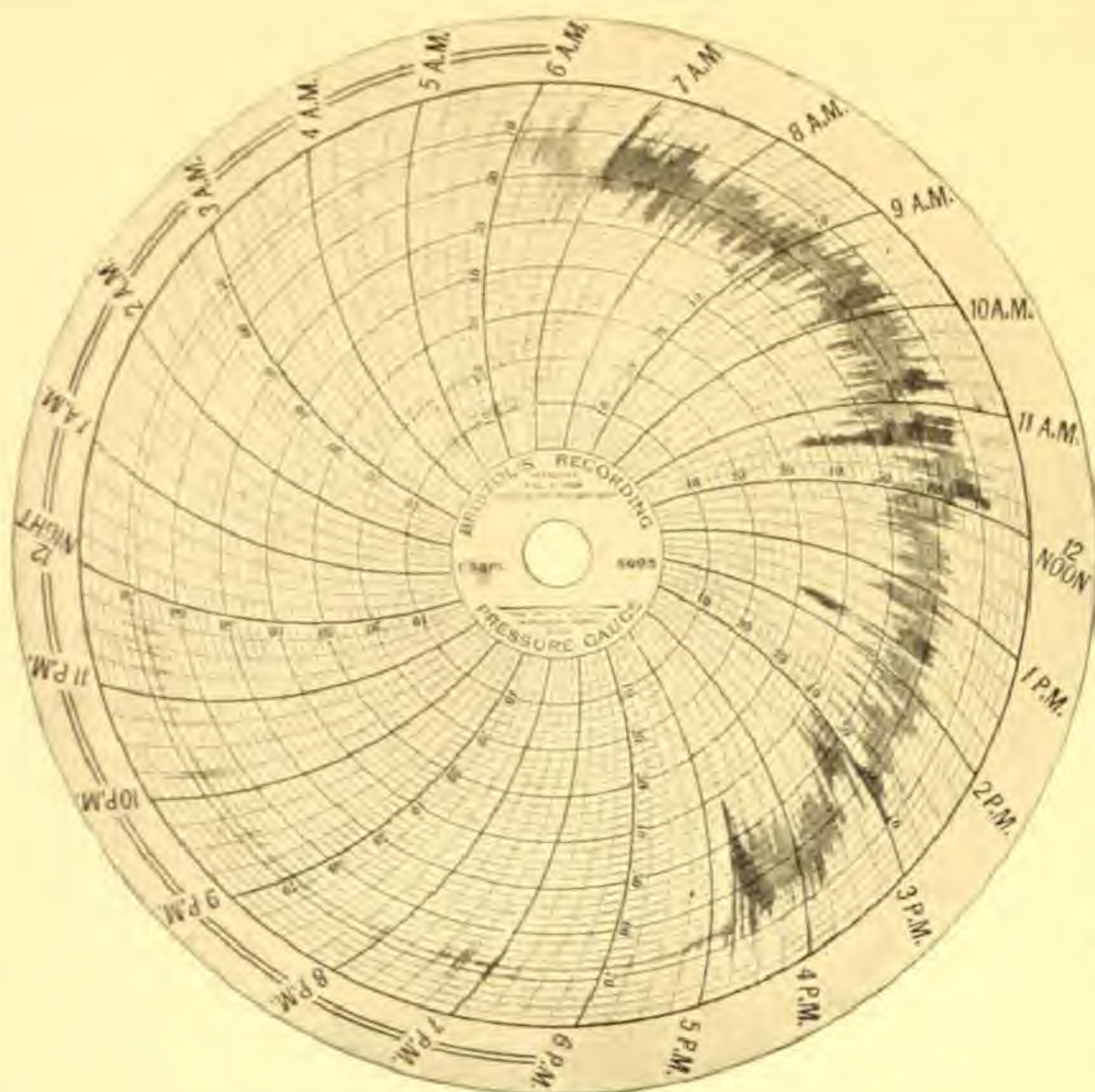
The same principle of operation used in the recording pressure gauges has also been adapted for use as a Recording Liquid Level Gauge. Such an instrument is used for recording the depth of liquids in tanks, reservoirs, rivers, etc. When used for this purpose, a sensitive bulb is supplied, which is immersed in the liquid, the depth of which is to be recorded, and is connected to the instrument by a flexible capillary tubing. The system is air-filled and thus is not affected by heat and cold, and may be installed out-of-doors without danger of impairing the accuracy. See pages 78 to 82 for further description.

### Long Distance Transmitting System

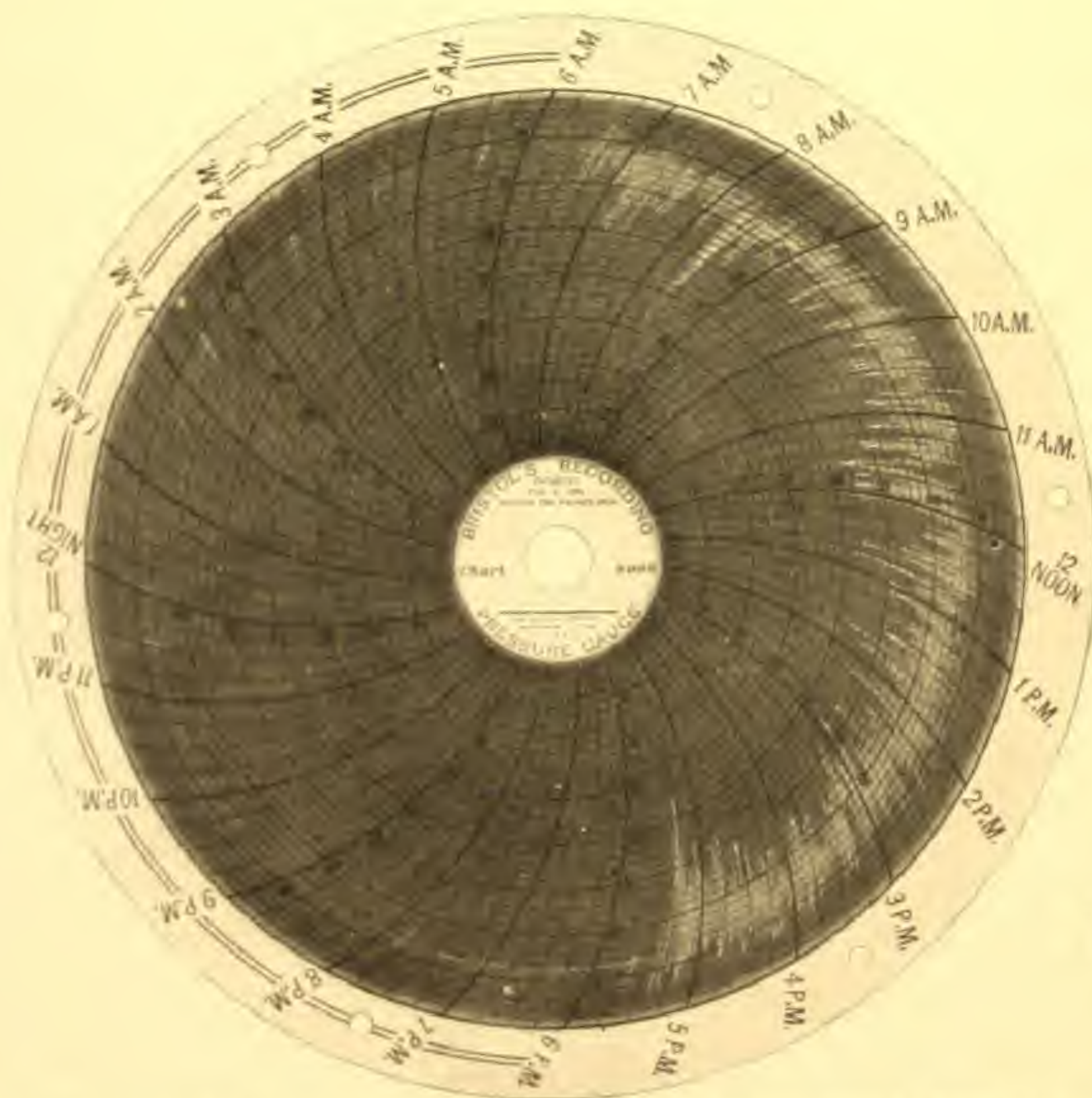
With Bristol's Long Distance Electric Transmitting System, records of Pressure and Liquid Level can be transmitted over distances of even several miles. It provides a means which permits the recording instruments to be installed at a convenient central location, and furnishes the knowledge of pressure and liquid level from distant points.

For instance: level of water in reservoirs; steam pressure at customer's premises, delivered from central heating plant, etc. This method of transmitting records is described on pages 32 and 33.





Record made with  
ink



Record made by  
patented smoked  
chart process

The above gives a comparison of the two methods of making records on round charts, i. e., ink and sensitized smoked surface. Either recording system can be supplied with Bristol's Round Chart Gauges.

TEMPERATURE

ELECTRICITY

MECHANICAL POWER



## SETH THOMAS CLOCK

Made Specially for Bristol's Recording Instruments

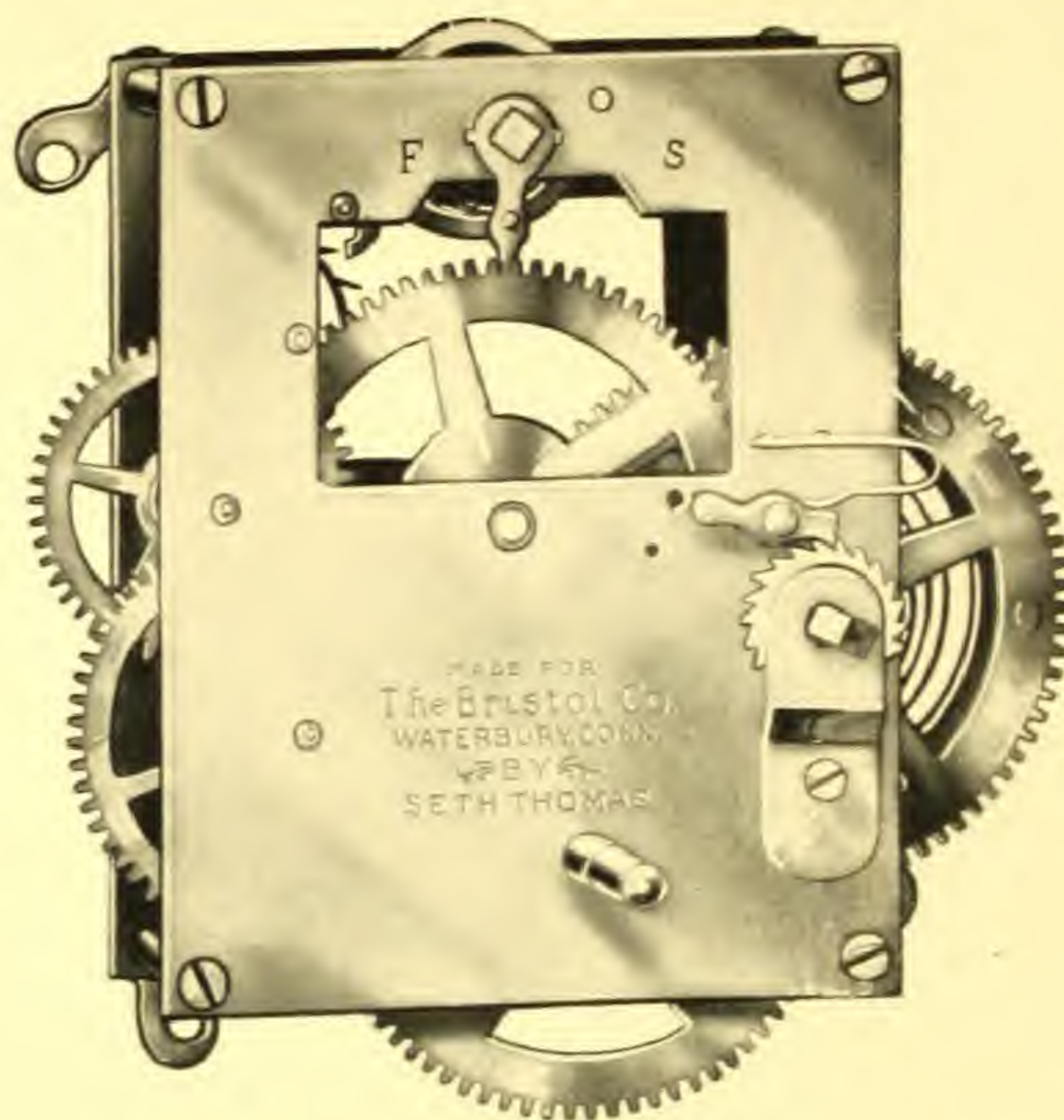


Fig. 1702

To revolve the charts in Bristol's Recording Gauges a clock movement is employed. The charts are divided into time arcs, thus, it is possible to know the exact time at which certain conditions occur.

The clock used is a specially designed "Seth Thomas" make. The reputation for high-grade workmanship and time-keeping qualities of Seth Thomas Clocks are so well known that further mention is uncalled for.

One complete revolution in twenty-four hours and seven days, are the two standard clock speeds. For test work faster speeds, 12 hours, 6 hours, 1 hour, etc., are furnished as required. However, one revolution in

fifteen minutes is the fastest ever recommended to use.

With charts which are changed daily, a clock making one complete revolution in twenty-four hours is used. The standard 24-hour clock requires winding every day; however, a clock with 24-hour speed and arranged to wind every seventh day can be furnished when desired. This is known as the weekly 24-hour clock, and only furnished when specified.

For charts making one continuous record in seven days, a 7-day speed clock is used. The 7-day clock will actually run for eight days with one winding. This gives ample power even on the seventh day, which insures an accurate and complete chart record.



## SOME OF THE REFINEMENTS FURNISHED WITH BRISTOL'S RECORDING THERMOMETERS

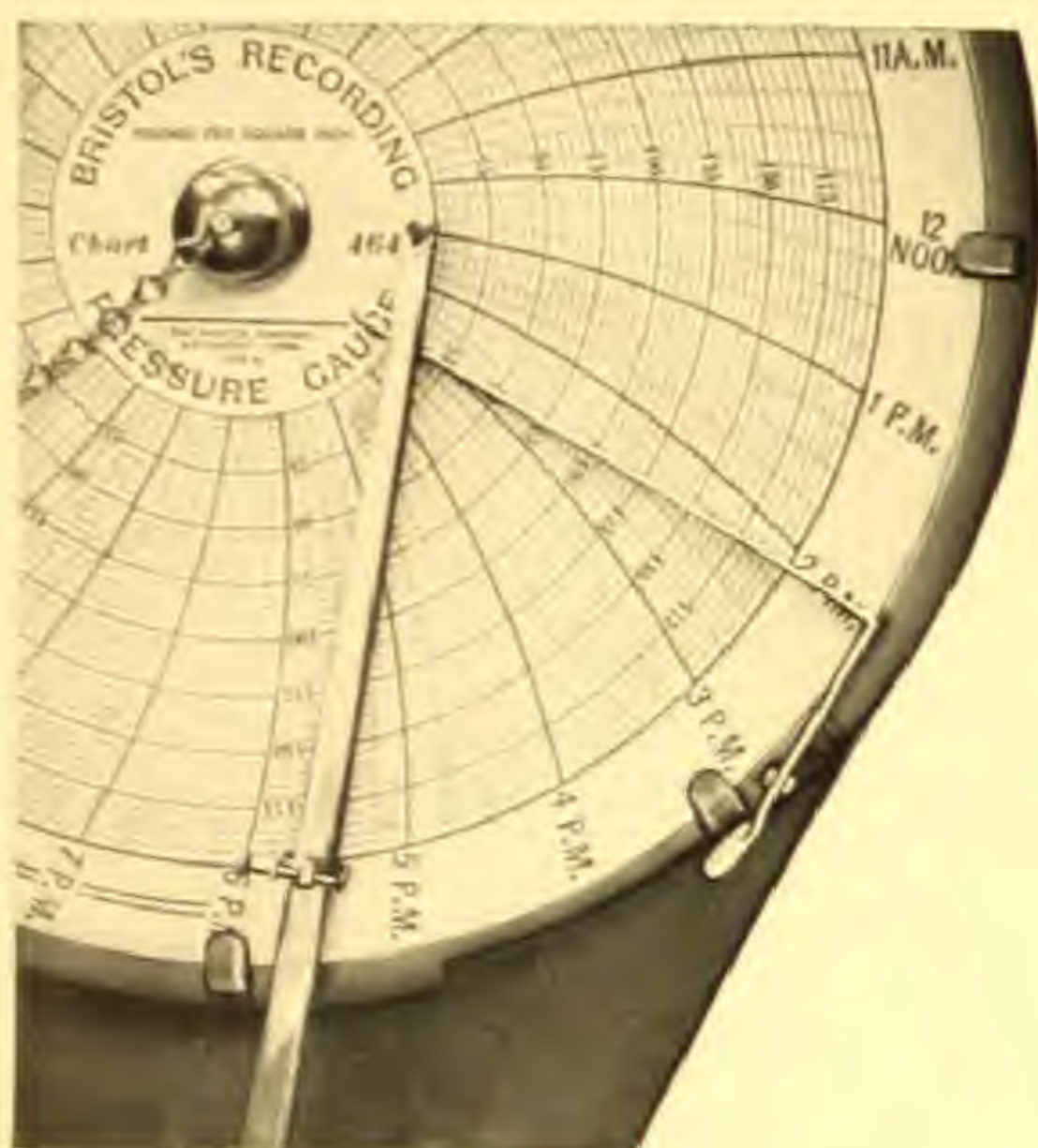


Fig. 1939

### Pen Lifter

This device is furnished as standard equipment with all Bristol's Recorders. With it the chart can be changed conveniently without spoiling the record or injuring the penarm. No extra charge is made for this feature.

### Micrometer Adjustable Pointer

The adjustable pen arm, as shown in Fig. 1939, is also furnished as standard equipment with all Bristol's Recording Thermometers. This simply necessitates turning the small screw to slightly change the adjustment of the Thermometer if this for any reason is necessary. When preferred the pivoted type of adjustable pen arm, shown in Fig. 1870, can be furnished instead. Either type does not influence the price of the instrument.

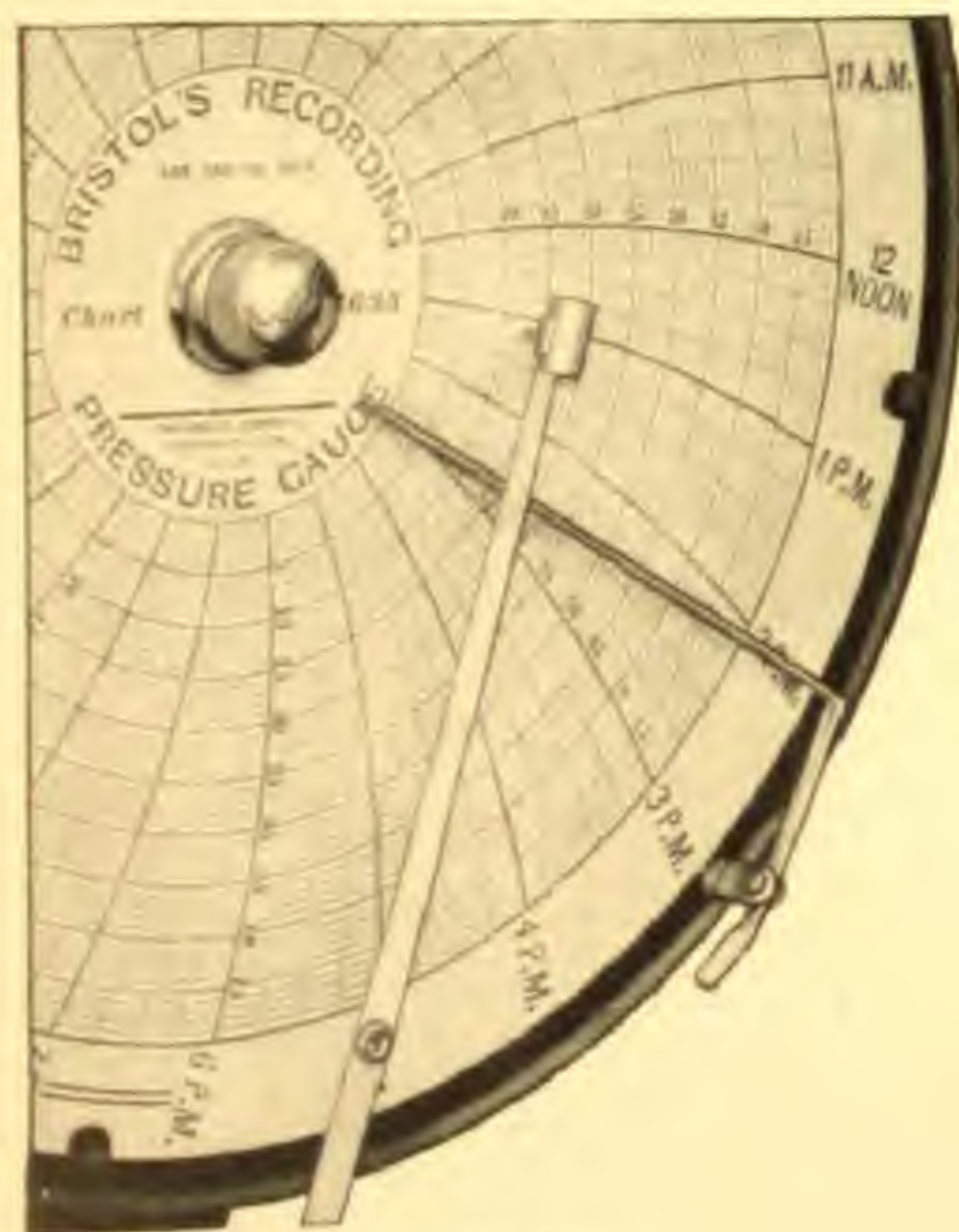


Fig. 1870

### Fountain Pen

Fig. 1870 illustrates the Fountain Pen furnished with Bristol's Recorders when specified. It is exceptionally useful in connection with applications where it is not possible to as frequently place ink in the pen as required by the V-shaped pen shown in Fig. 1939. The Fountain Pen draws a very fine line and can be attached to any Bristol's gauge. Price, 60 cents list.

TEMPERATURE

RECORDING

SERIAL NO.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

## HELICAL TYPE PRESSURE ELEMENT

For High Ranges



Fig. 2170

For higher ranges above ten pounds pressure the helical form of pressure element is used, as illustrated above. This helical pressure element is a metal tube closed at at one end and coiled. The pressure is admitted to the inside, and when exerted has

a tendency to uncoil or straighten the tube. The penarm is fastened directly to the end of the tube and pressures are recorded on the chart without the aid of any multiplying devices. The extreme simplicity of this is a unique feature.



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## DIAPHRAGM TYPE OF PRESSURE ELEMENT

For Low Ranges

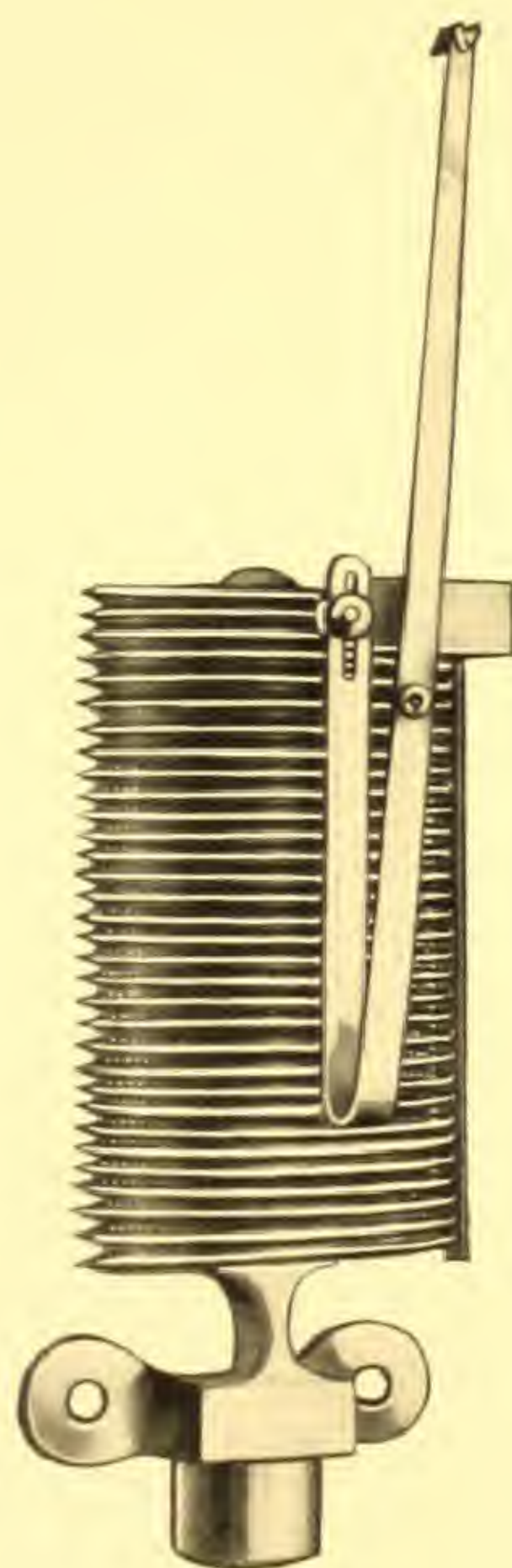


Fig. 2172

This shows the diaphragm pressure element for lower ranges from four inches to fifteen inches head of water pressure.

The diaphragm form of pressure element is composed of helical metal discs connected in the center and strapped together on one side. The pressure is admitted at the bottom and as the discs are fastened together at one

side, movement is only permitted in one direction. The pen arm is attached to the top of the pressure element and records directly on the chart without using any multiplying devices.

This same pressure element mounted in a portable model instrument is shown on page 18.



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## BOX TYPE PRESSURE ELEMENT



Fig. 1942

The box type of pressure and vacuum element shown above can be furnished for ranges not exceeding 10 pounds per square inch, or less than 15 inches head of water. These elements are very simple in construction, like all other working parts used in Bristol's Recording Gauges.

The construction consists of a short diaphragm tube enclosed in a pressure-tight box. The pressure or vacuum is applied on the inside of the box and the outside of the diaphragm tube, which operates the recording

pen arm by means of a shaft firmly attached to the bottom of the tube.

The advantage of this design for certain applications is that excessive pressure may be applied to this type without injuring it.

The movement is absolutely dead-beat and very positive in its action, which is an important feature when the pressure fluctuates rapidly, or when the instrument is subjected to excessive vibrations.

Uniform scale graduations are also obtained with the box-type pressure element.

Above  
pressure  
The Bris  
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construct  
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gives a  
The  
can be



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REG. U. S. PAT. OFFICE

## COMBINATION PRESSURE AND VACUUM ELEMENT

Patented November 26, 1912



Fig. 1941

Above is shown the patented design of pressure element furnished exclusively by The Bristol Company for combined pressure and vacuum gauges. It is of very simple construction and makes it possible to read vacuum and pressure on the same chart with an extra clear vacuum scale having very open graduations.

The construction is practically the same as original form helical tube for low range, and is restrained by a helical spring, which gives a suppressed scale for the high range.

The advantage of this element is that it can be used on various combined ranges of

pressure and vacuum, giving a vacuum scale which will extend over a greater portion of the chart than could be obtained with the original helical type. For example, on charts having a range extending over about  $\frac{1}{8}$  of the total chart scale, but with the patented design explained above, the vacuum scale would cover about  $\frac{1}{4}$  of the total chart scale. It is, therefore, possible to read the vacuum scale very closely, and at the same time the instrument is suitable for a high pressure range. Specimen sections of charts shown on page 63, Chart 2255 and Chart 2256.

TEMPERATURE

PRESSURE

VACUUM



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 REG. U. S. PAT. OFFICE  
**RECORDING PRESSURE GAUGE**  
**ORIGINAL FORM MODEL 11**

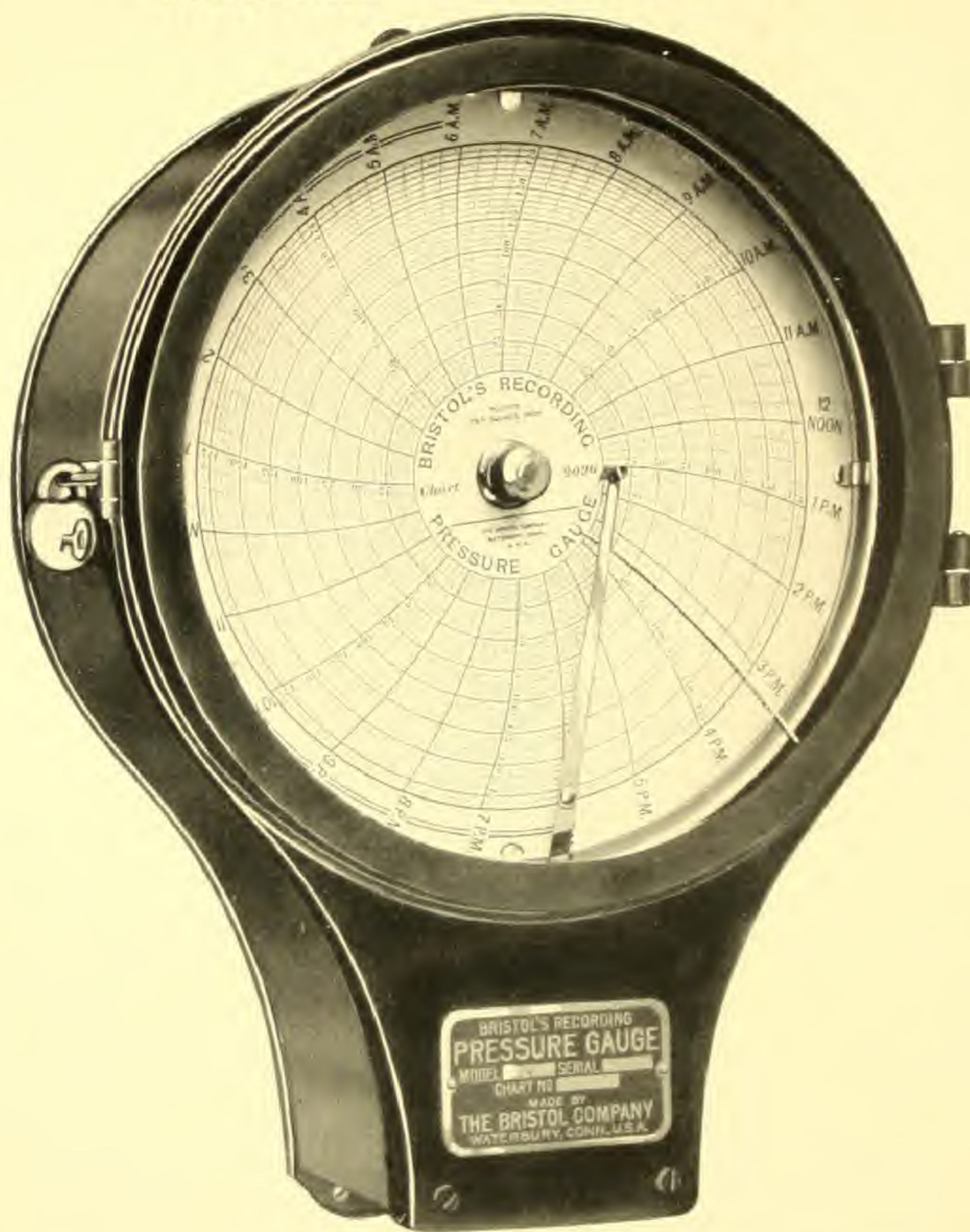


Fig. 1854

Suitable for mounting on switchboard or wall—can be furnished with 12-inch or 8-inch diameter charts for total ranges up to 12,000 pounds pressure per square inch, as listed on pages 36 to 66. Standard finish of case is black enamel.

This is known and universally recognized as the typical "Bristol's" Instrument. It is similar in form to the first Bristol's Record-

ing Gauge made, over thirty years ago, and is known as the Original Form. The case was designed to fit the working parts of the instrument, and for this reason allows unhampered operation of the moving elements.

Extensively used in connection with condensers; steam heating systems; steam boilers; water supply lines, and hundreds of other applications.



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 REG. U. S. PAT. OFFICE

## RECORDING VACUUM GAUGE ORIGINAL FORM MODEL 11



Fig. 1867

For recording total ranges of 1-inch water vacuum to 30-inch mercury vacuum. The instrument is extremely sensitive and capable of recording even slight changes in vacuum or draft conditions. Furnished with charts 12 inches and 8 inches in diameter. Standard finish of case is black enamel.

Recording Gauges are also furnished to

record combination vacuum and pressure; illustration on page 11 shows the type of pressure element used. See chart lists giving ranges and units of measurement.

Such an instrument supplies valuable information in regard to draft for the firing and operation of boilers and kilns; also, condenser vacuum, exhaust fans, etc.



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## RECORDING PRESSURE GAUGE MOISTURE-PROOF MODEL 40



Fig. 1948

If gauge is to be installed where it will be exposed to moisture, chemical fumes, dust or dirt, the Model 40 Moisture-Proof Case should be used. In fact, it is desirable in any location where a case more rugged than Model 11 is required.

Model 40 case is made of cast iron, finished in black enamel. The door is hung

on heavy hinges and is made tight with rubber gasket and screw clamps used to fasten it. The glass is held in place with metal clamps and made moisture-proof and dust-proof with cemented gasket.

The working parts of the instrument are same as used in Model 11, and can be furnished with 12-inch or 8-inch diameter charts.



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## RECORDING PRESSURE GAUGE WATER-PROOF MODEL 45

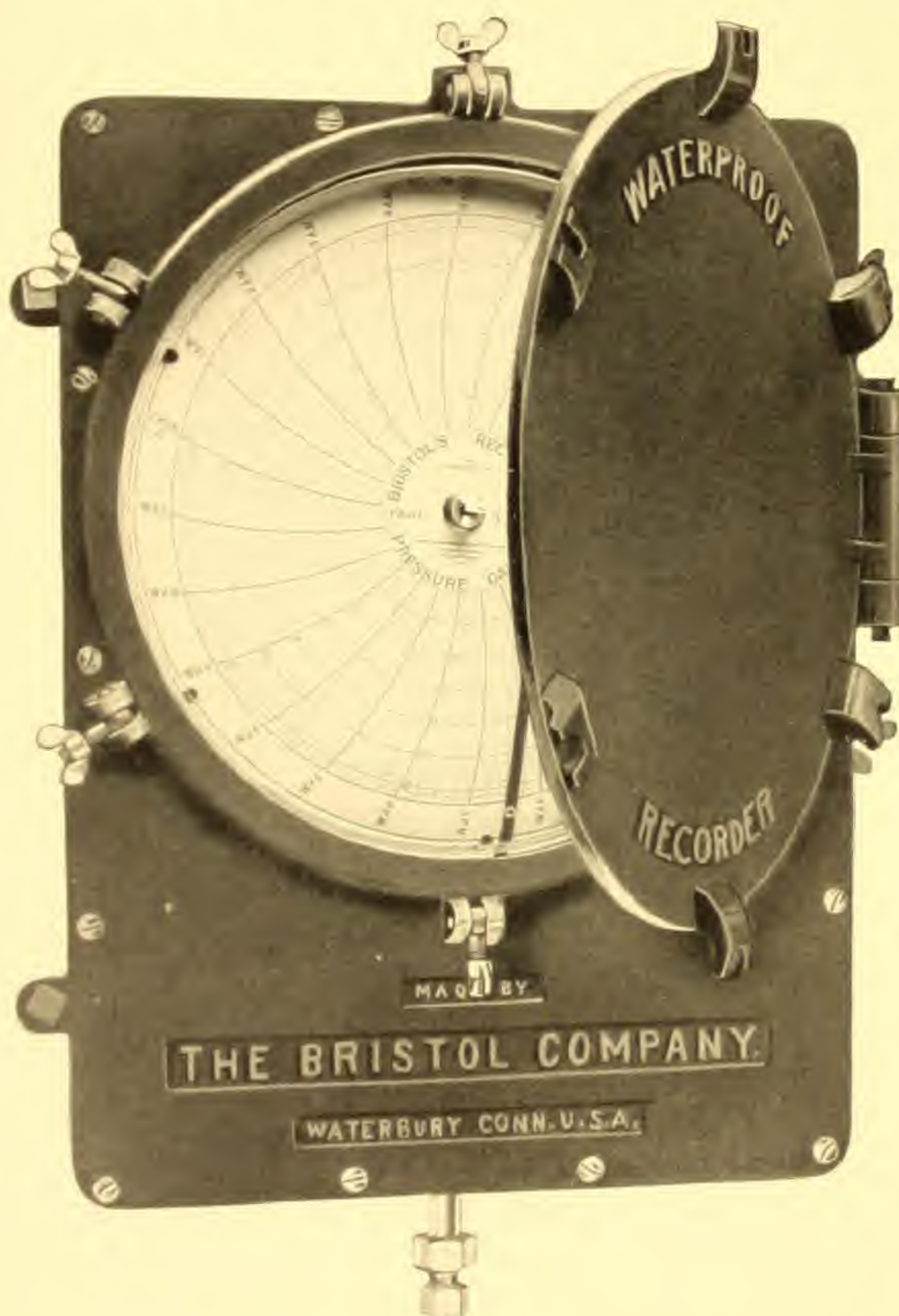


Fig. 1856

For out-of-door installations, in man-holes and cellars, wherever there is a possibility of the instrument becoming entirely submerged in water, the Model 45 Water-proof Case gives complete protection.

The case is cast iron with black enamel finish, and made water-proof with gaskets and clamps.

This instrument uses same movement as Model 11 and charts 12 inches and 8 inches in diameter.

TEMPERATURE

ELECTRICITY

MOTION ETC.



TRADE MARK  
BRISTOL'S  
REG. U.S. PAT. OFFICE

## RECORDING PRESSURE GAUGE ROUND FORM MODEL 61

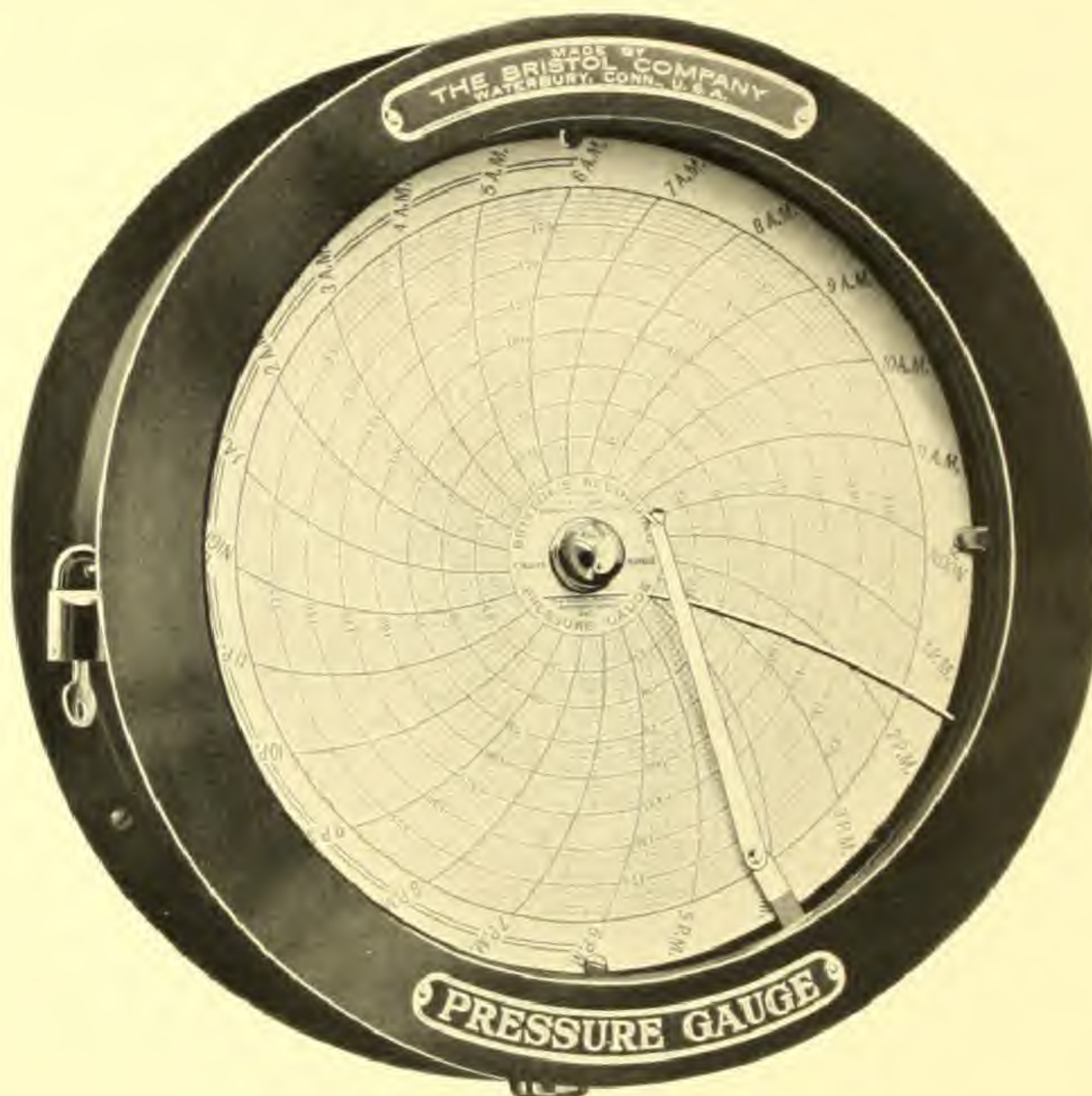


Fig. 1699

Oftentimes a gauge with round-form case is required to economize in space or to conform to specifications in order to match other instruments. The Model 61, shown above, takes care of such requirements. Although the price of this instrument is lower than the standard Model 11, it embodies the features which make it a desirable and durable instrument where the round-form case is required.

The finish of Model 61 case is black enamel. The charts used can be furnished in two sizes, 10 inches and 8 inches in diameter, as given in list on pages 71 to 75.

Another Round Form Model Gauge is shown on page 23. The case of this Model 41 is even more rugged than Model 61, and is moisture-proof and dust-proof. These models are only very slightly different in appearance and the same charts are used for both.



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## RECORDING PRESSURE GAUGE ECCENTRIC FORM MODEL 47

(Used with 6-Inch Charts Only)



Fig. 1691

The Model 47 Gauge is usually referred to as the 6-inch chart instrument. However, in actual measurement, the charts used are  $6\frac{1}{2}$  inches in diameter. This instrument furnishes a very compact record and for such applications where it is not required to read the graduations too closely, fills every requirement for a recording gauge.

This eccentric form of case allows the use of the same pressure element and affords very nearly as wide an angle of deflection as obtained in the Model 11. The price of Model 47 is lower than for other models, yet when used for the applications for which it is adapted, is in every way a desirable instrument.



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## RECORDING PRESSURE GAUGE PORTABLE MODEL 12

With "U" Tube

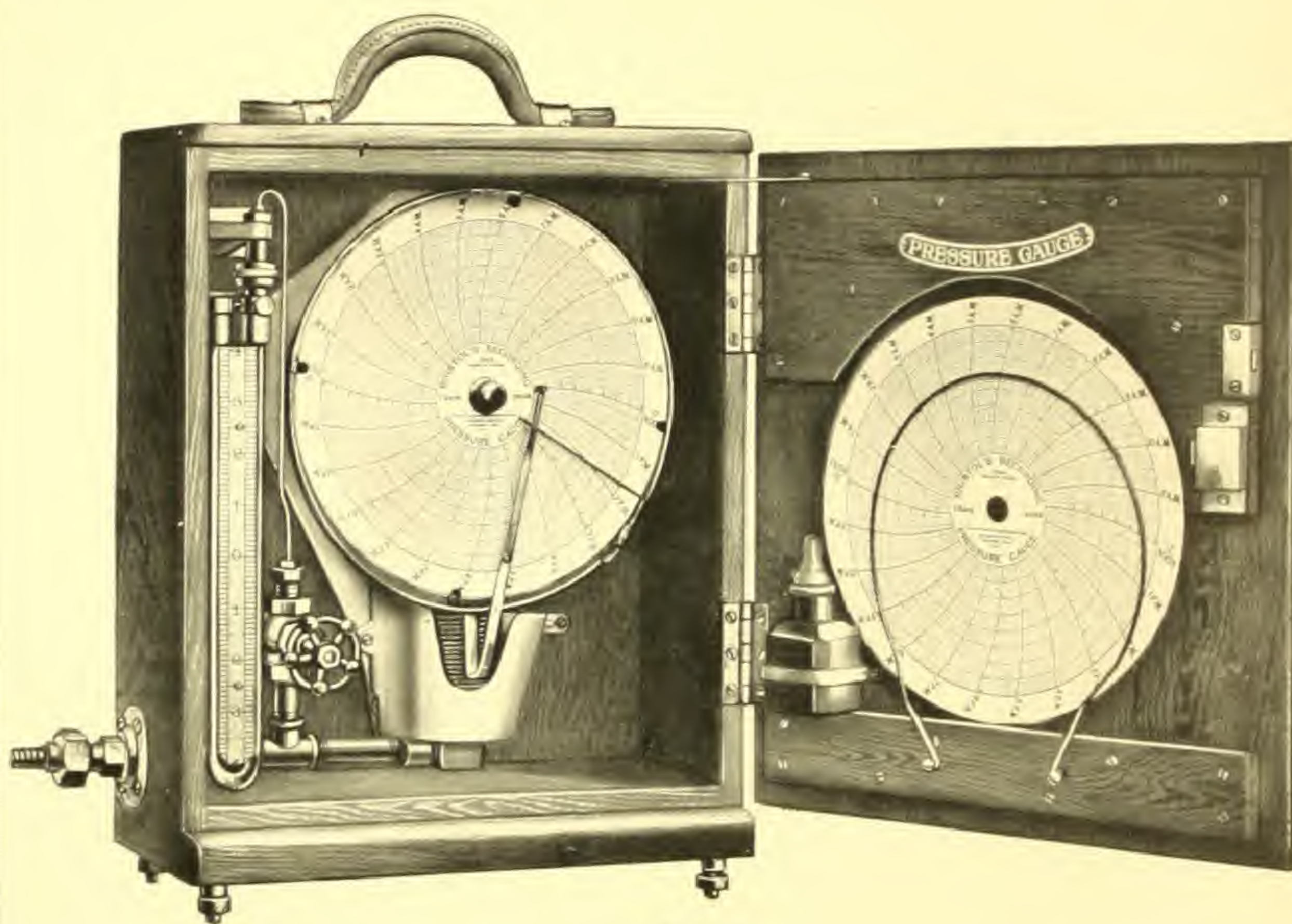


Fig. 1885

A portable recording gauge like this is very widely used by gas companies and water works to obtain records of pressures at various locations in the distributing systems, and on customer's premises. A pressure survey such as it is possible to make with Bristol's Recording Gauges, furnishes valuable engineering data in regard to making changes and extensions, and useful in helping to settle customer complaints.

The instrument illustrated is equipped with the diaphragm pressure element used

for the lower ranges of pressure. A metal guard, as shown, around the pressure element, provides a protection from mechanical injury, possibly caused by excessively rough handling and carrying about of the portable instrument. This guard is a standard feature and furnished with all Bristol's portable gauges.

As a continuous check on the accuracy of the recording gauge, a "U" tube like that shown above, is sometimes furnished. This "U" gauge is not a regular fixture, but supplied only when specified at an additional charge.



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## RECORDING PRESSURE GAUGE PORTABLE MODEL 12

For High Ranges

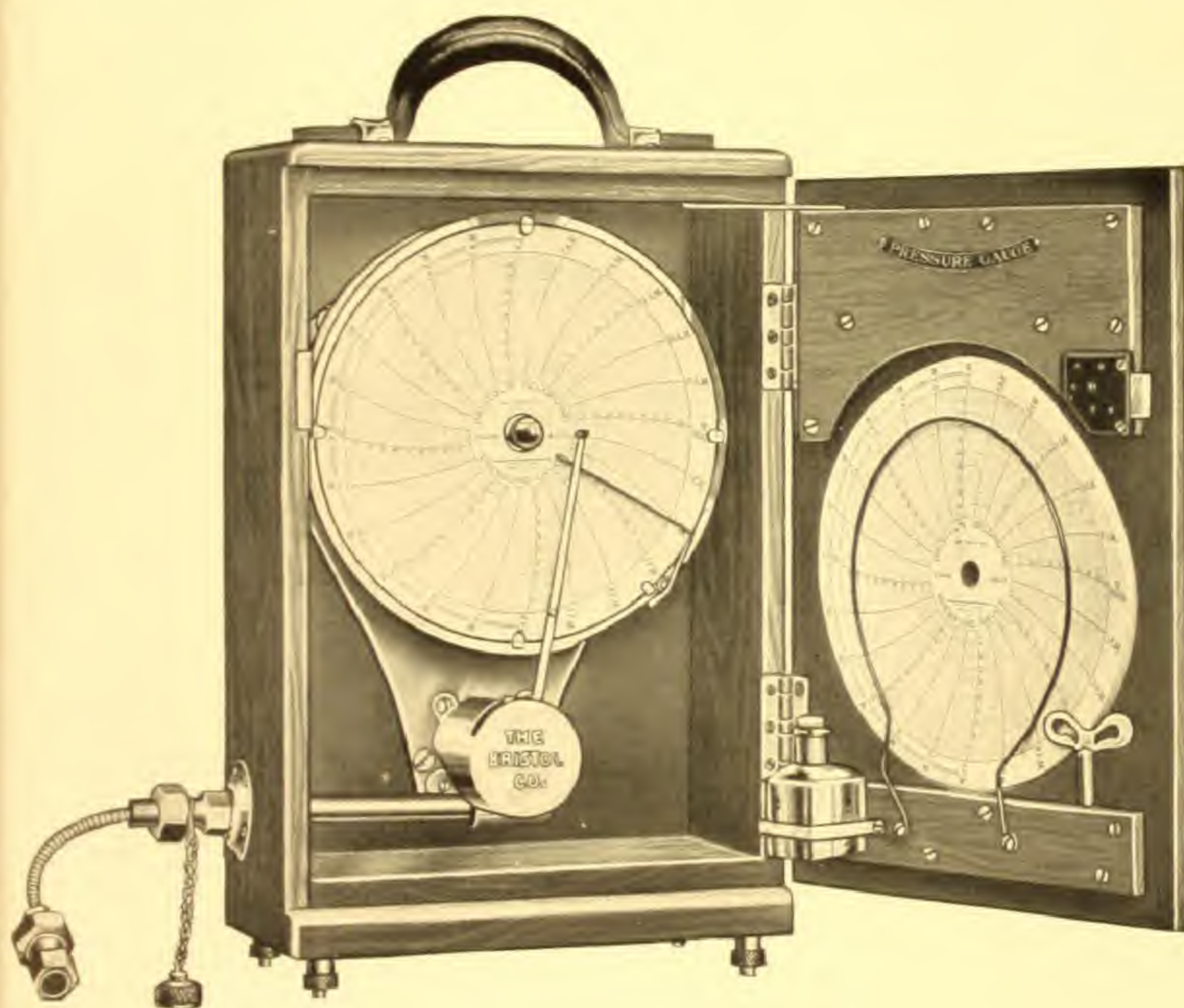


Fig. 2178

The portable recording gauge shown above is designed for high range work and for this reason is equipped with helical type of pressure element. This is the same pressure element as illustrated on page 8, but is here shown enclosed in metal case which provides mechanical protection. This feature is desirable in the portable instrument because they are oftentimes subjected to very rough usage.

The rugged construction and simplicity

of Bristol's Gauges is well illustrated in this instrument. It shows how the penarm is attached directly to the pressure element and records on the chart without the use of complicated levers, gears, or other multiplying devices.

This portable recording gauge has a wooden case with compact and convenient arrangement. The working parts are same as used in Model 11, also Charts 12 inches and 8 inches in diameter.



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## RECORDING PRESSURE GAUGE MOISTURE-PROOF MODEL 40, INVERTED TYPE

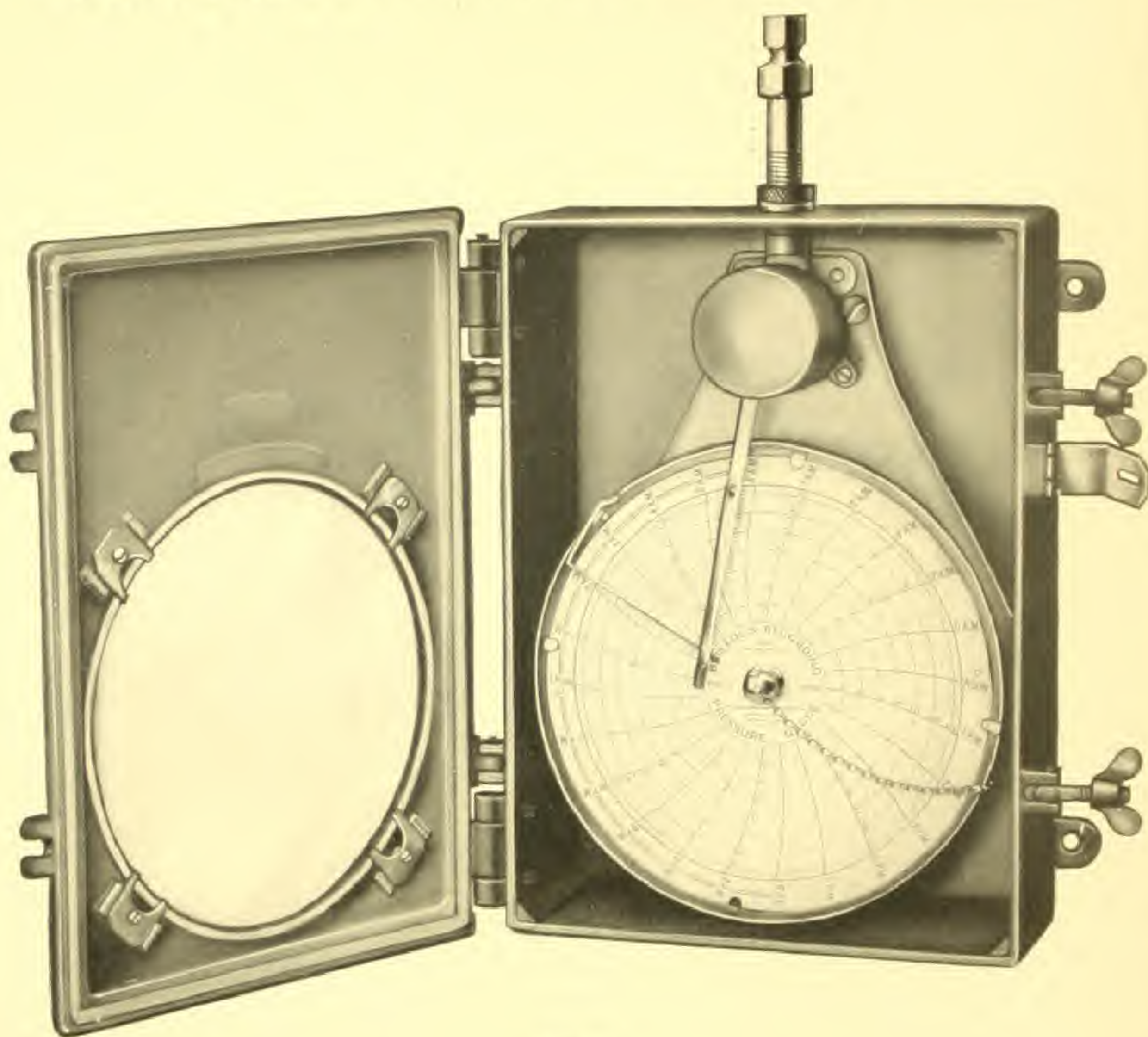


Fig. 1937

To conform with specifications, and for certain applications it is desirable to use recording gauge with penarm operating from the top. Any Bristol's Recording Gauge with range of 15 inches' water and over can be furnished in the inverted type.

Working parts and principle of operation are same as with the vertical penarm instrument, only mounted and calibrated to operate from the inverted position.

Same charts are used with this instrument as with the standard Model 40; the price is also the same.

Top connection is standard, but can be furnished top-back and bottom connection when required.

When ordering, if inverted type is desired it should be specified, otherwise the standard vertical type will be furnished



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## RECORDING PRESSURE GAUGE MOISTURE-PROOF MODEL 40, INVERTED TYPE

Equipped with Two Pen Arms

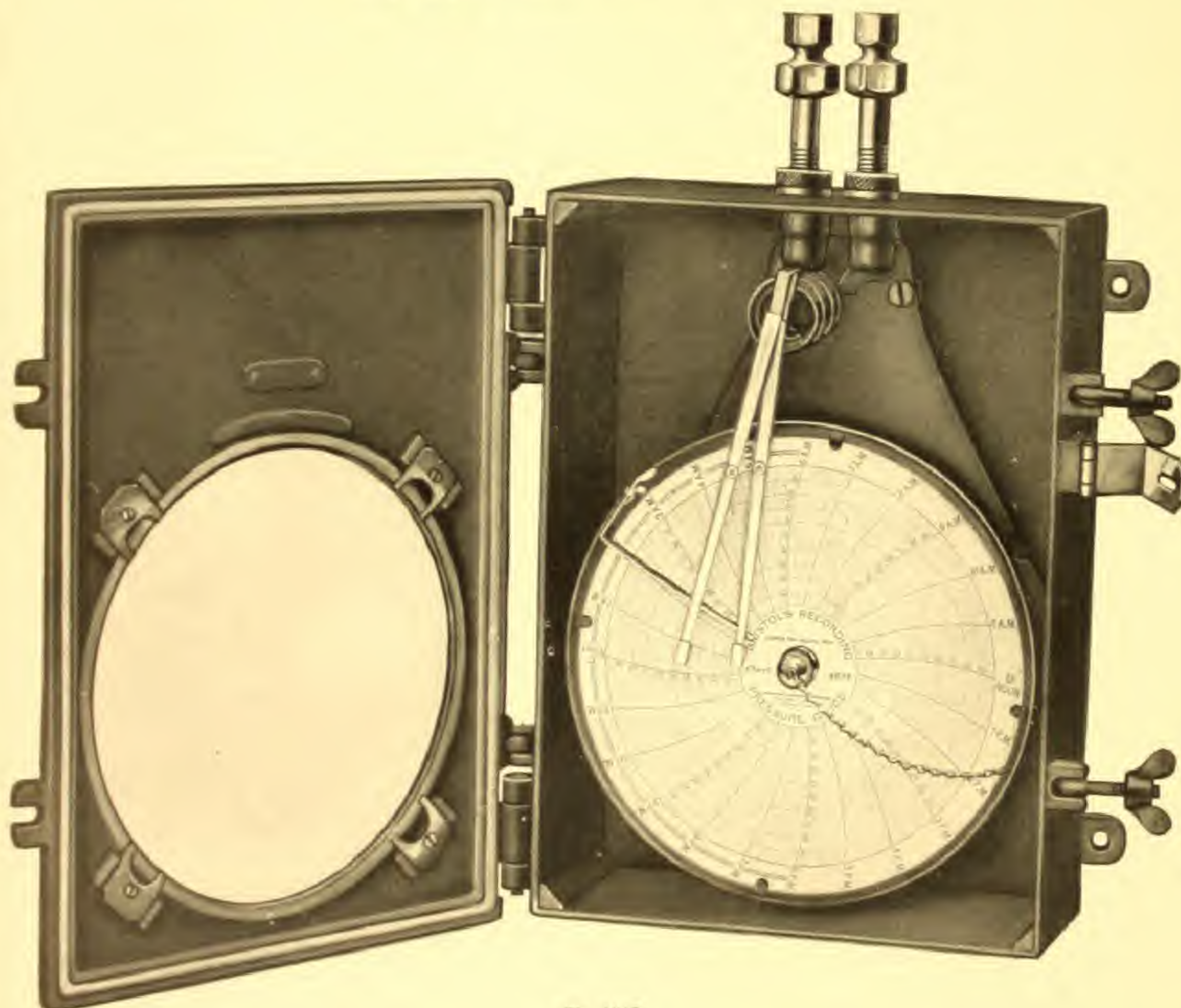


Fig. 1945

This instrument utilizes two complete working systems arranged with two penarms to record on the same chart. To make the records very distinctive different colors of ink are used on the pens.

A convenient record for easy comparison, of two different operations of pressure is supplied by such an equipment. For example—steam pressure at inlet and outlet of turbine.

To determine the cost, multiply the price for single-pen instrument by  $(1\frac{3}{4})$ .

A combination two-pen instrument can be furnished to record pressure and temperature on the one chart. Only one set of graduations are used for both the temperature and pressure, but to distinguish them, there are two separate sets of figures printed in different colors. One application for such an instrument is to record pressure and temperature of superheater steam.

Price of combination pressure and temperature instrument quoted on request.



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# **RECORDING PRESSURE GAUGE ROUND FORM MODEL 41 INVERTED TYPE**

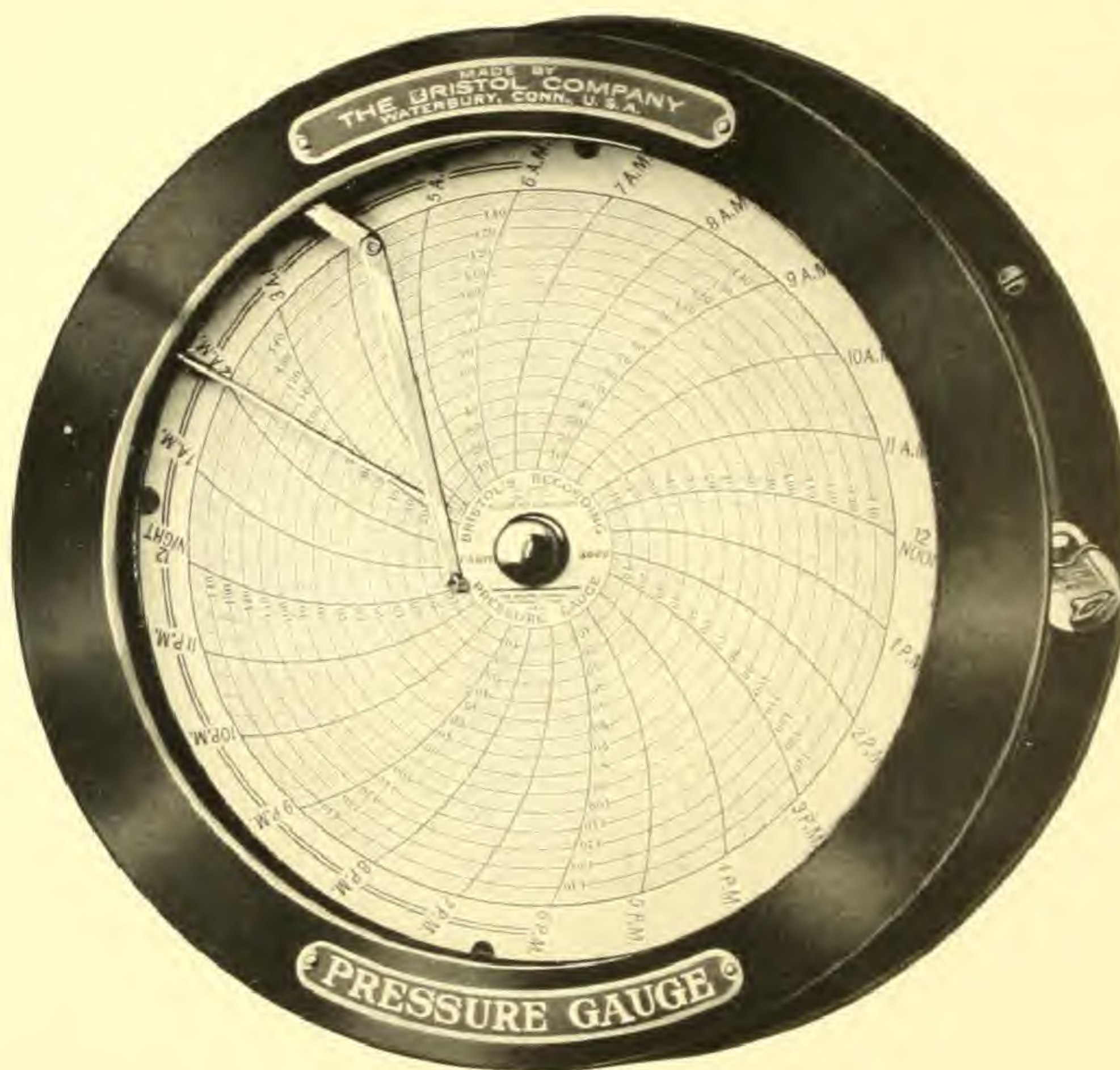


Fig. 1869

Pen arm, in the above instrument, instead of being located in the usual vertical position, is arranged to operate from the top. Instruments made up this way are called the Inverted Type.

The gauge shown is Model 41 Inverted Type, but any Bristol's Recording Gauge

with range of 15 inches water and over can be furnished made up this way.

Same charts are used with this instrument as with Model 41; the price is also the same.

Top connection is standard, but can also be furnished top-back and bottom connection when required.



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## RECORDING PRESSURE GAUGE ROUND FORM MOISTURE-PROOF MODEL 41

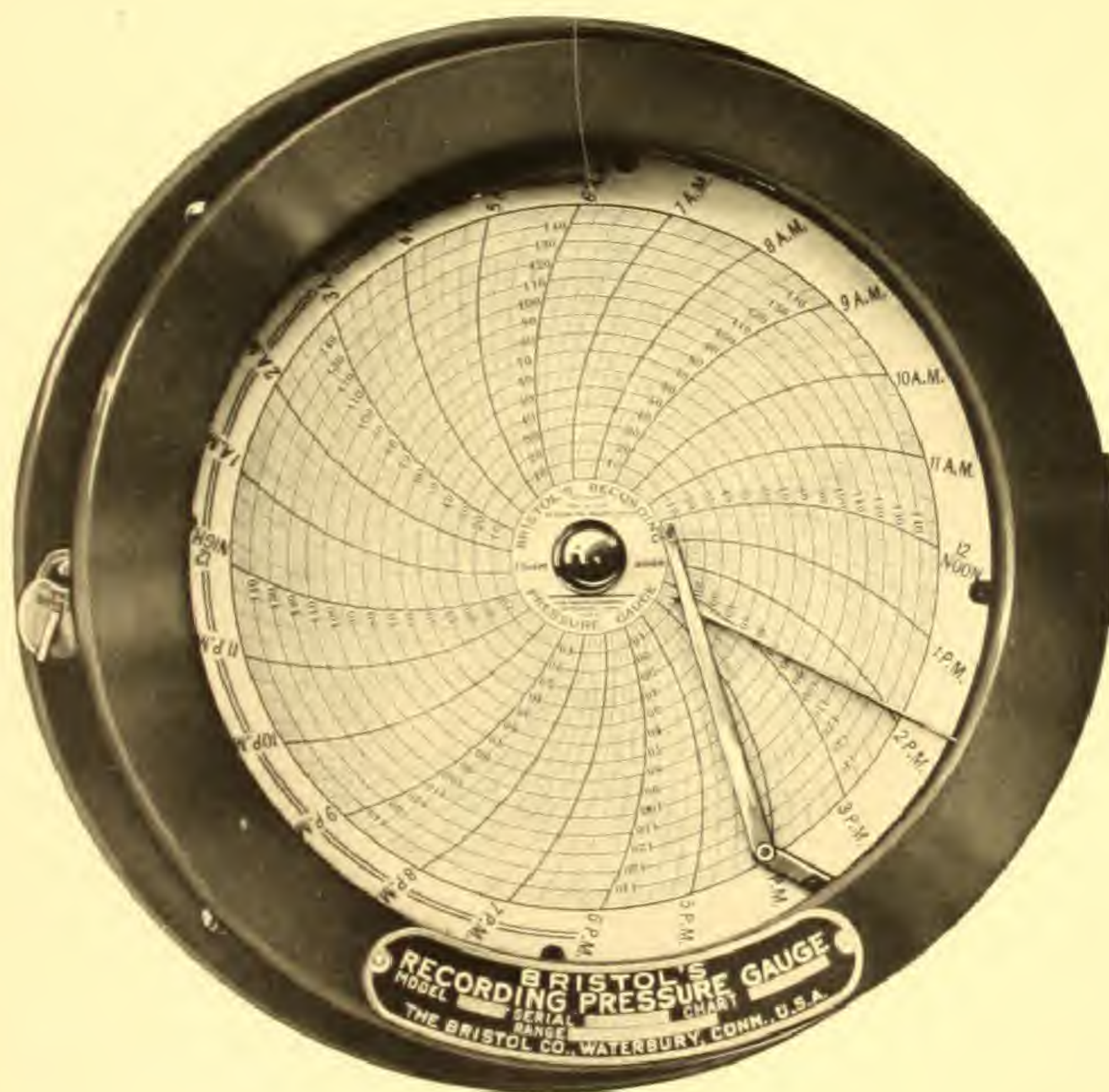


Fig. 1887

A moisture-proof case of the round-form type, similar to Model 61 is available in Model 41. The case is cast iron with black enamel finish; made moisture-proof with rubber gasket. This provides a very rugged case, especially adapted for installation where

it will be subjected to excessive atmospheric moisture, chemical fumes and dust or dirt.

The working parts are exactly the same as those used in Model 61, and uses the same 10-inch and 8-inch diameter charts, as listed on pages 71 to 75.



TRADE MARK  
**BRISTOL'S**  
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**RECORDING PRESSURE GAUGE  
WITH ELECTRIC TIME RECORDING PEN ARM**

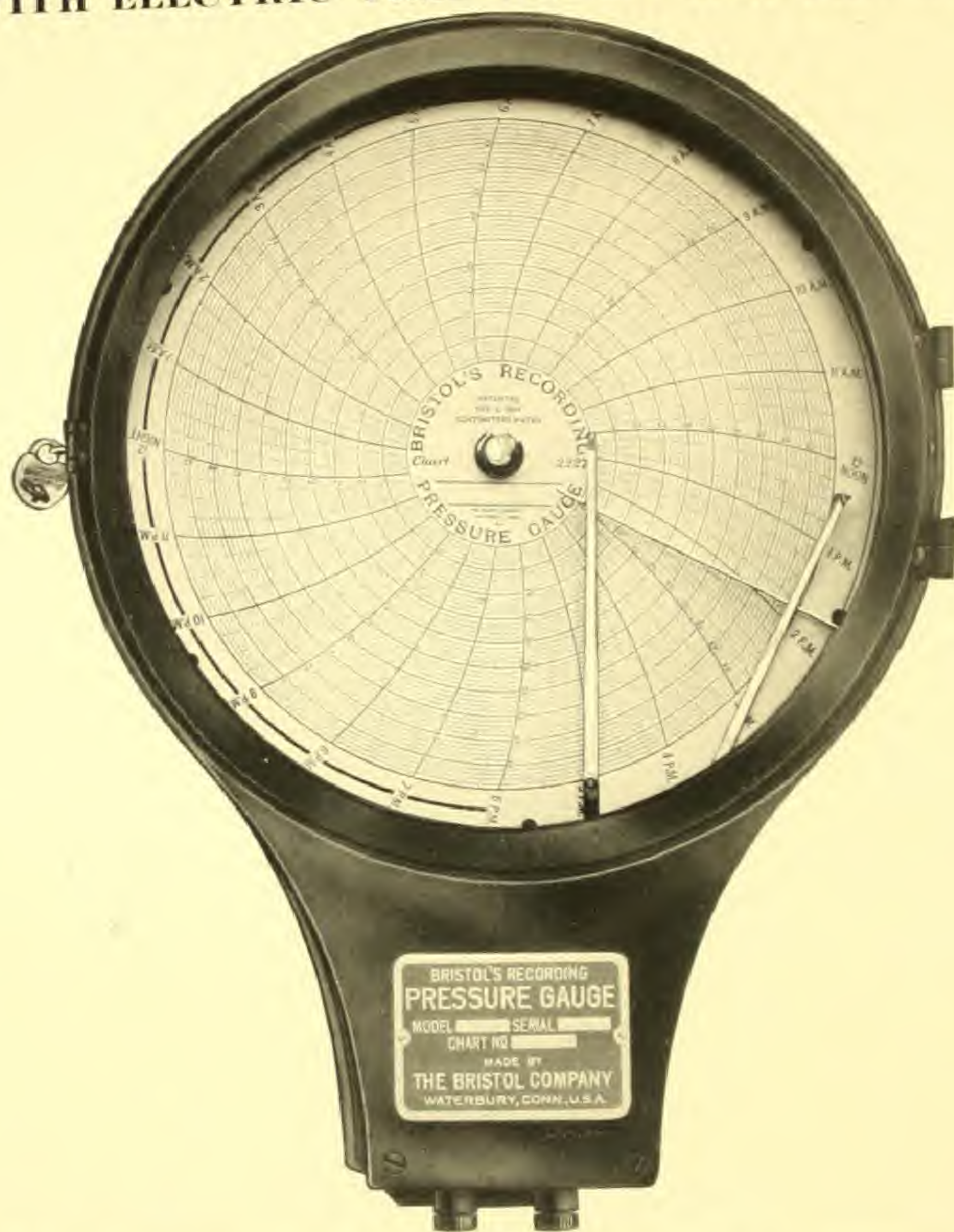


Fig. 1868

There are mechanical operations, in connection with some processes requiring the recording of pressure, which it is also important to know about, such as the opening and closing of doors and traps, the operation of valves, switches, etc. To take care of such conditions an Electric Time Recording Pen Arm to operate on the outer edge of the chart, is furnished in connection with the Recording Pressure Gauge. Such an attachment not only records the fact of operation, but also the time and duration.

Electric Time Attachment can be furnished with 12-inch Model 11 Gauge, also 12-inch and 8-inch Model 40, for all ranges.

Battery or lighting circuit can be used for operating the Electric Time Attachment. To the regular price for the recording gauge, add (\$25.00) extra list for Electric Time Attachment arranged for use with battery, and (\$35.00) extra list arranged for lighting circuit. The latter price includes transformer.



## AUTOMATIC ELECTRIC ALARM

Used with Bristol's Recording Gauges



Fig. 2167

Alarm Bell, to warn of too high or too low pressures can be furnished to automatically operate from Bristol's Recording Gauges. Such an alarm is used to inform the operator of the approaching danger point, and is often a very important addition to the regular service rendered by the recording instrument.

Only the external parts of the electric alarm are shown here—including bell, dry battery and bell wire. The equipment inside the instrument consists of a contact device installed back of the dial, so arranged to make contact at two points (high and low) on the scale. These contact points are adjustable and can be changed, as desired, within the scale range, to suit individual requirements.

The bell is connected to the recorder by ordinary bell wire and is operated by current from Dry Cell Battery. Contacts can also be furnished to operate from lighting circuit

110 volt A. C. or D. C. and when necessary 220 volts. When used with D. C. a special bell is required for which an additional charge is made. With A. C. a transformer must be used and can also be furnished if desired.

When Automatic Electric Alarm Attachment is required, it should be specified on order with instrument; it cannot be satisfactorily installed outside of the laboratory. Recording Gauges now in the field should be returned to the factory to be equipped with Electric Alarm Attachment.

**AUTOMATIC ELECTRIC ALARM ATTACHMENT** complete, including Bell, Dry Cell, 100 feet of Bell Wire, and Adjustable Contact Device, mounted and adjusted to Bristol's Recording Gauge.

List Price .....\$25.00

**AUTOMATIC ELECTRIC ALARM ATTACHMENT** for use with lighting circuit. Prices quoted on request.

TEMPERATURE

ELECTRICITY

MOTION ETC



## WOODEN PROTECTION CASE

For Protecting Instrument from Dust, Fumes, Dampness, Tempering, Etc.



Fig. 1871

A wooden case, like illustration, is used as an added mechanical protection of the recording instrument from dust, dirt, smoke, etc. The glass door makes it possible to clearly see the chart with record at all times. It is provided with a lock and key, which also prevents meddling by irresponsible parties.

The case illustrated is for Model 11 Gauge, but cases similar in appearance are furnished in suitable sizes for other models.

Wooden Protection Case for:

12-inch Model 11	List Price, \$18.75
8-inch Model 11	" " 16.50
8-inch Model 61	" " 16.50
6-inch Model 47	" " 16.50

## REPLACEMENTS

(When ordering replacements refer to diagram below.)

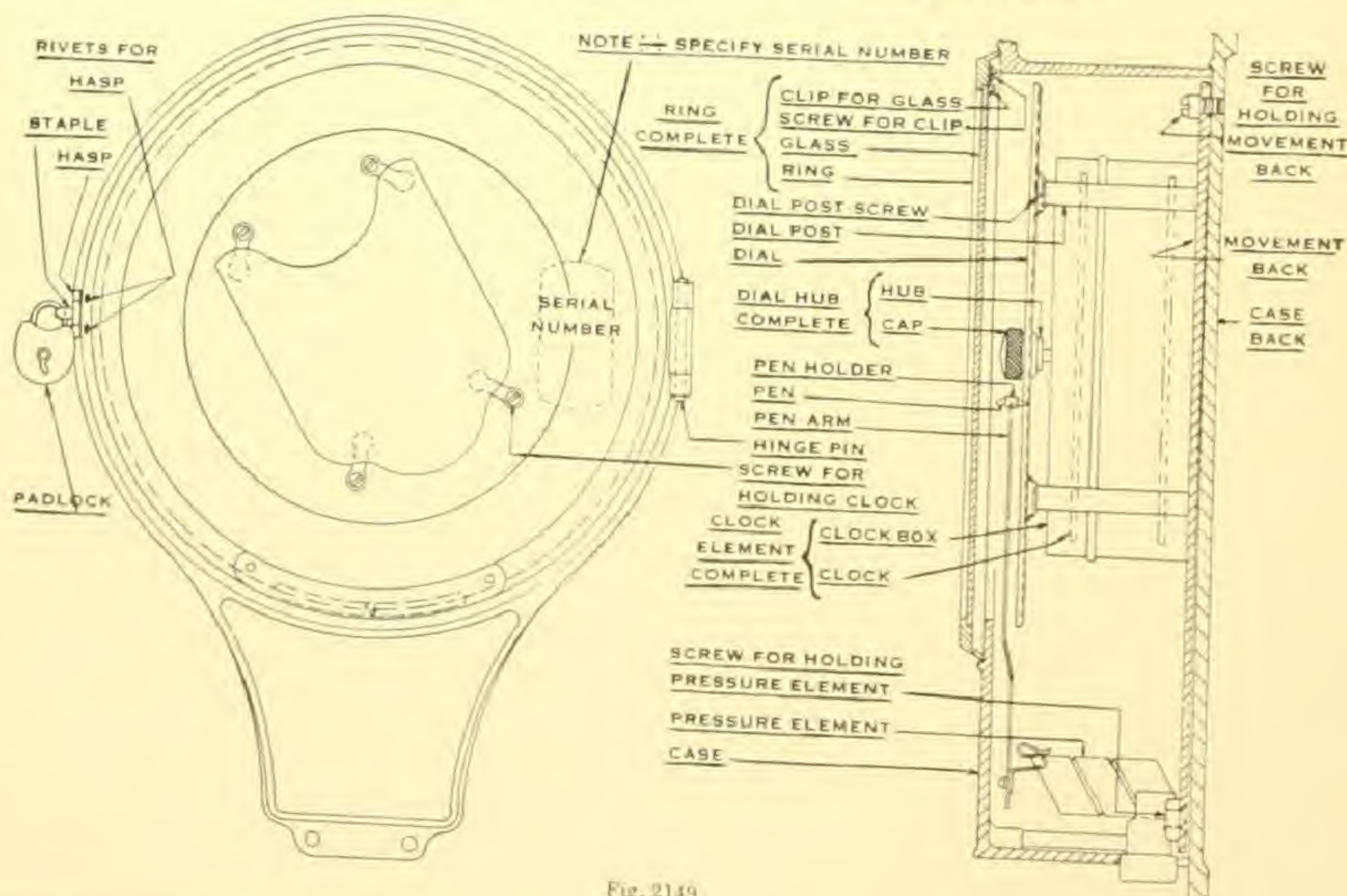


Fig. 2149



## DRILLING DIAGRAMS

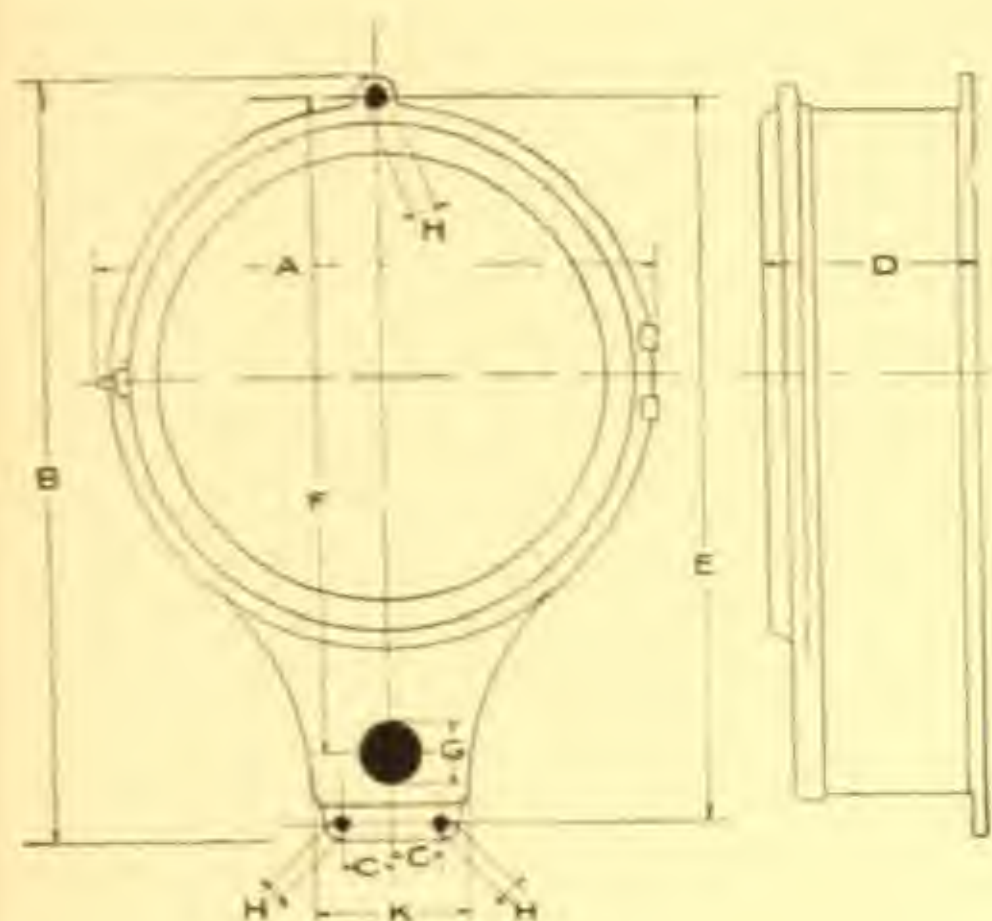


Fig. 1922  
Model No. 11

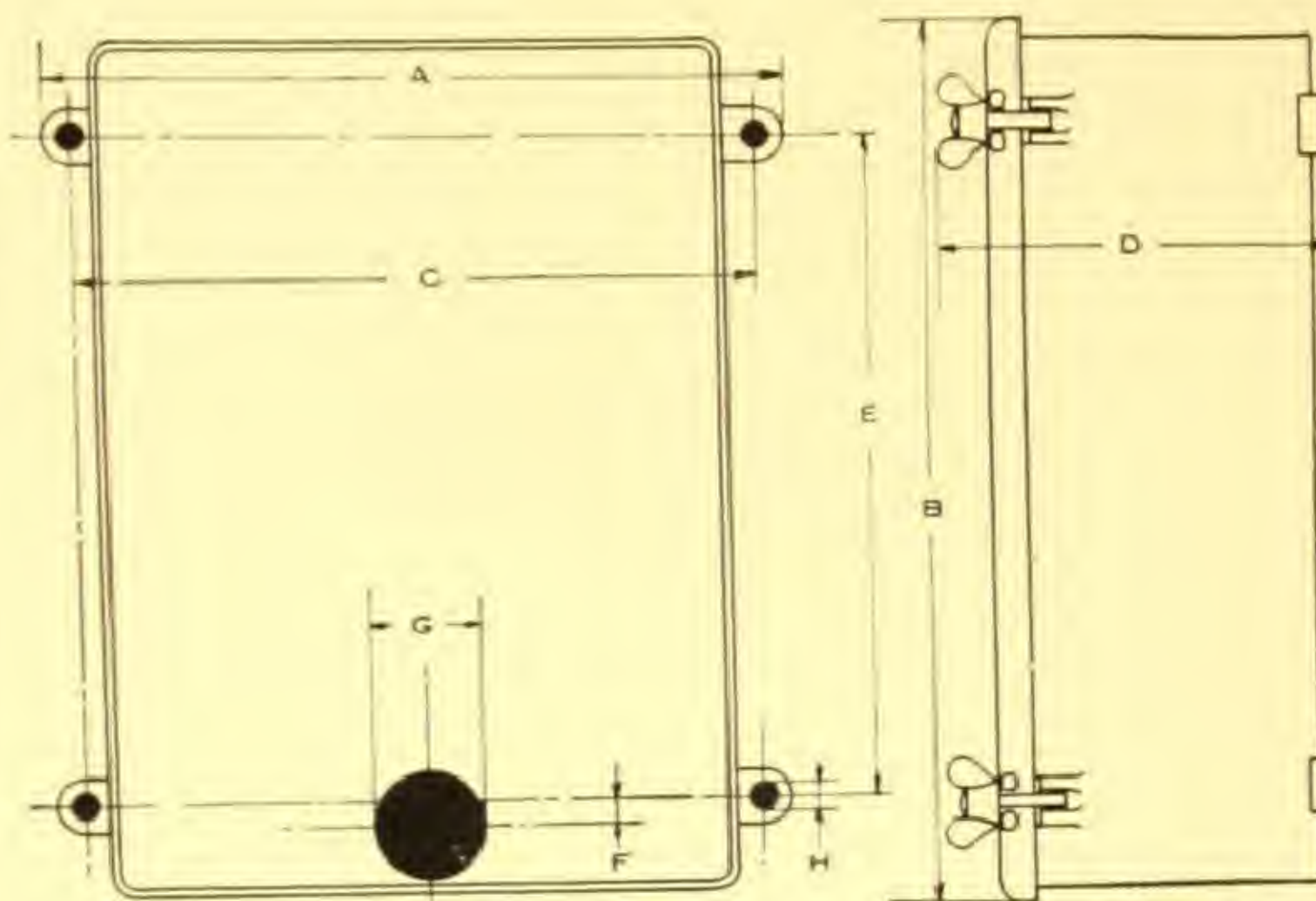


Fig. 1923  
Models 40 and 45

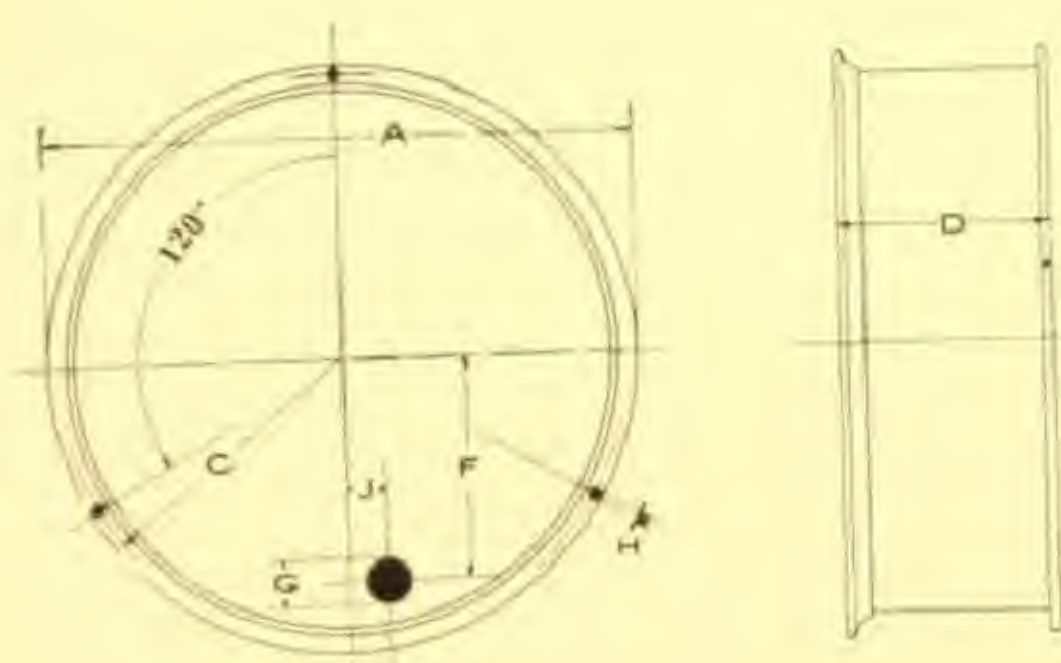


Fig. 1924  
Models 41, 47 and 61

WRITE FOR DRILLING PRINTS,  
Stating Model  
Size  
And your Order Number covering the Instrument

TEMPERATURE

ELECTRICITY

MOTION ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

## RECORDING PRESSURE GAUGE STRIP CHART TYPE MODEL 25

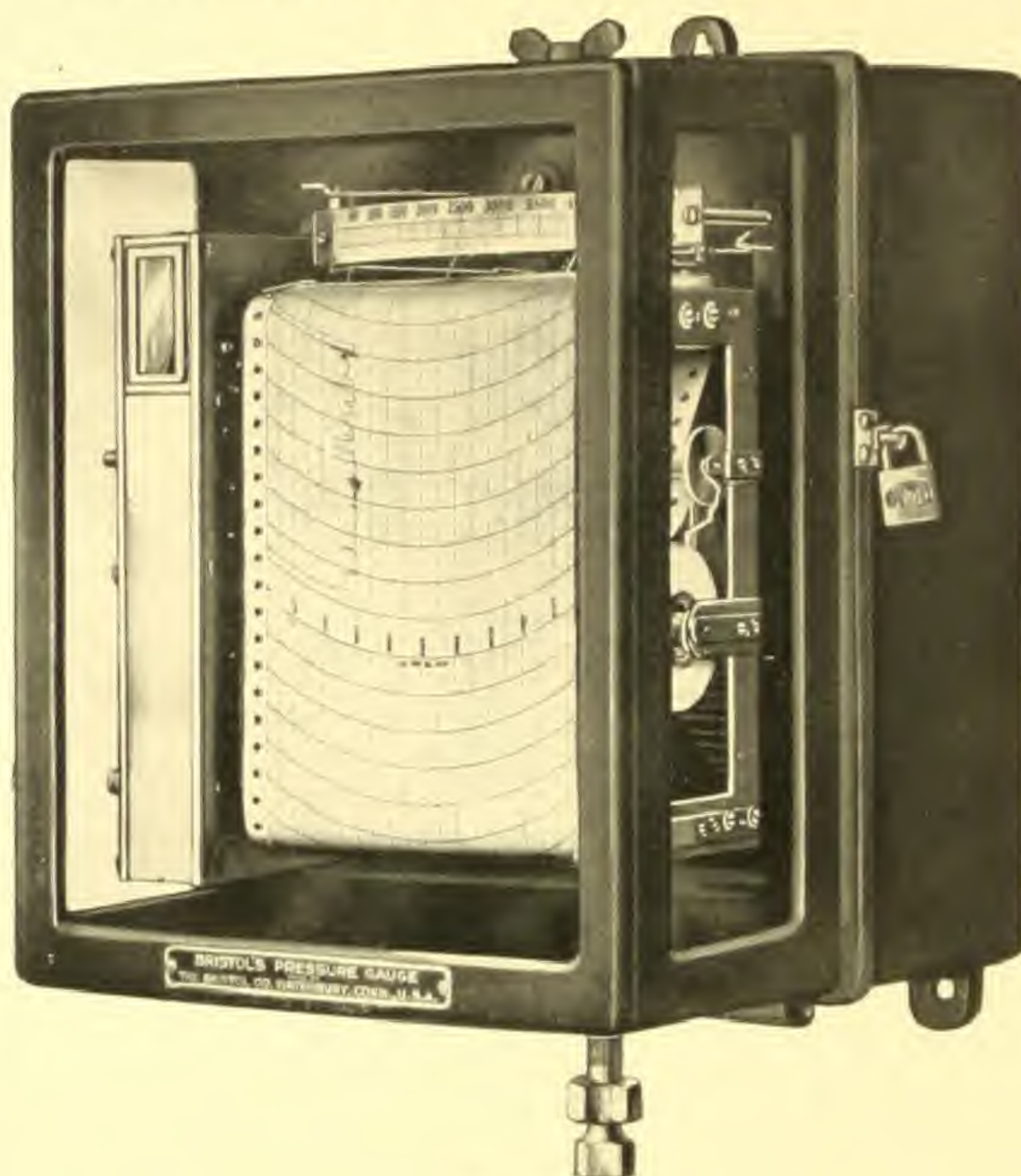


Fig. 2171

Strip Chart Recording Gauge, makes it possible to secure an unbroken record for about 45 days' duration. The only attention necessary is to wind the clock every seventh day.

Principle of operation is same as in round chart recording gauge, using the same type of pressure element. It is in every way equal to the round chart type instrument.

Charts are 6 inches in width, with scale  $5\frac{1}{4}$  inches wide. Furnished in rolls of 90 feet and 30 feet long. The scale divisions are orange color with black figures for scale units and time markings.

Recording System, is direct marking with ink, usually red.

Clock speeds are readily adjusted for 1 inch, 3 inches and 6 inches per hour; also for 1 inch, 3 inches and 6 inches per minute, which makes this type of instrument especially valuable for making experimental tests.

Straight pressure or vacuum, also combination pressure and vacuum instruments can be furnished in the strip chart type gauge. When two-pen instrument is required these are made with double-movement and double-scale chart. A strip chart type gauge for all ranges above 20-inches water, can also be furnished as receiving recorder in connection with Long Distance Transmitting System.

Prices quoted on request.



## SPECIMEN STRIP CHART WITH RECORD

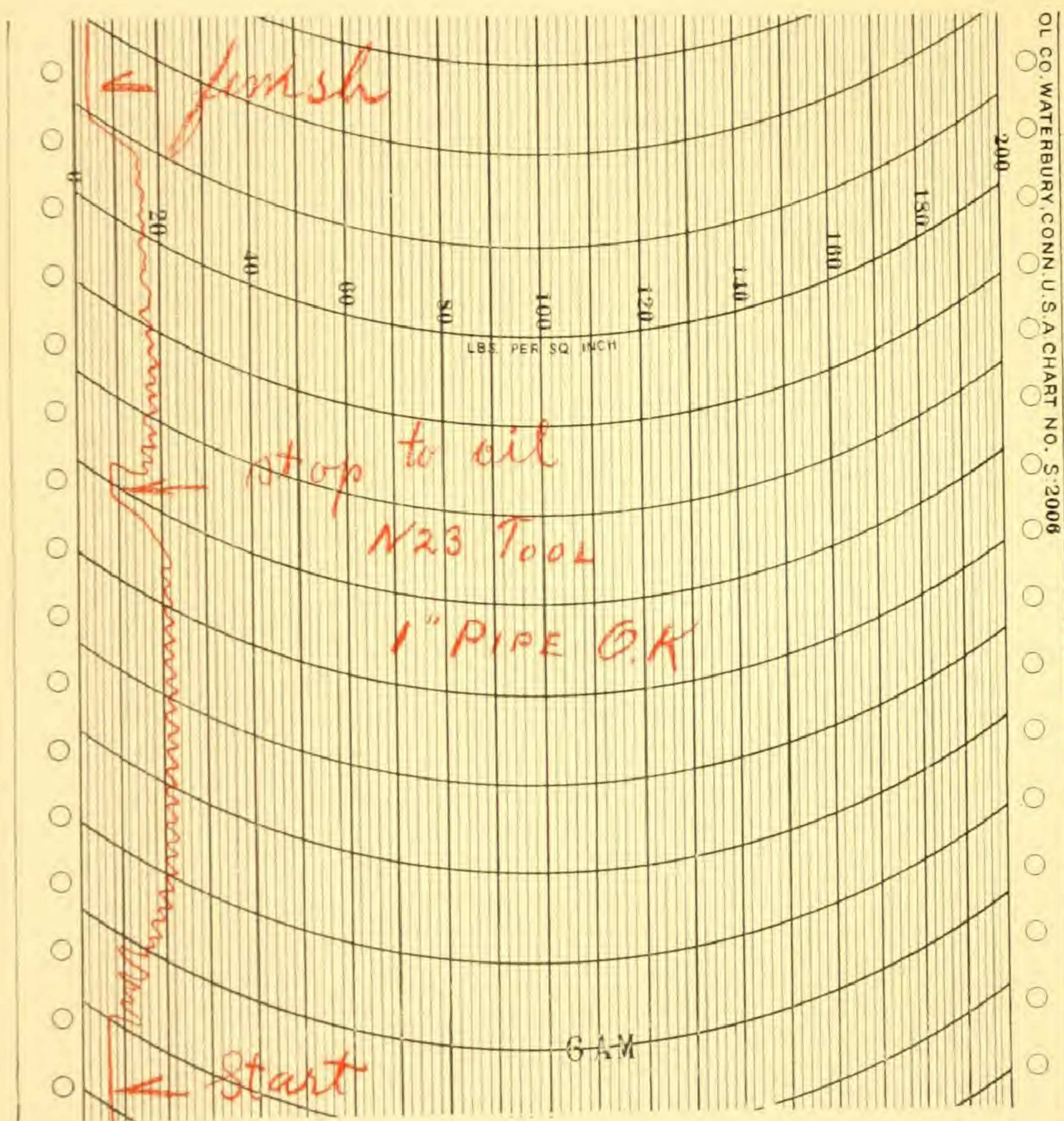


Fig. 1956

The record on the above Strip Chart shows the pressure in pounds of pull required to cut threads with die-stock. Used as a test by maker of die-stocks. The notes on

the chart show the complete story. It is interesting to know the chart was traveling at the rate of 6 inches per minute for this particular test.



## PROTECTION SEALS

For Protecting Interior Working Parts from Injury by Chemical Action,  
Excessive Temperature, Etc.

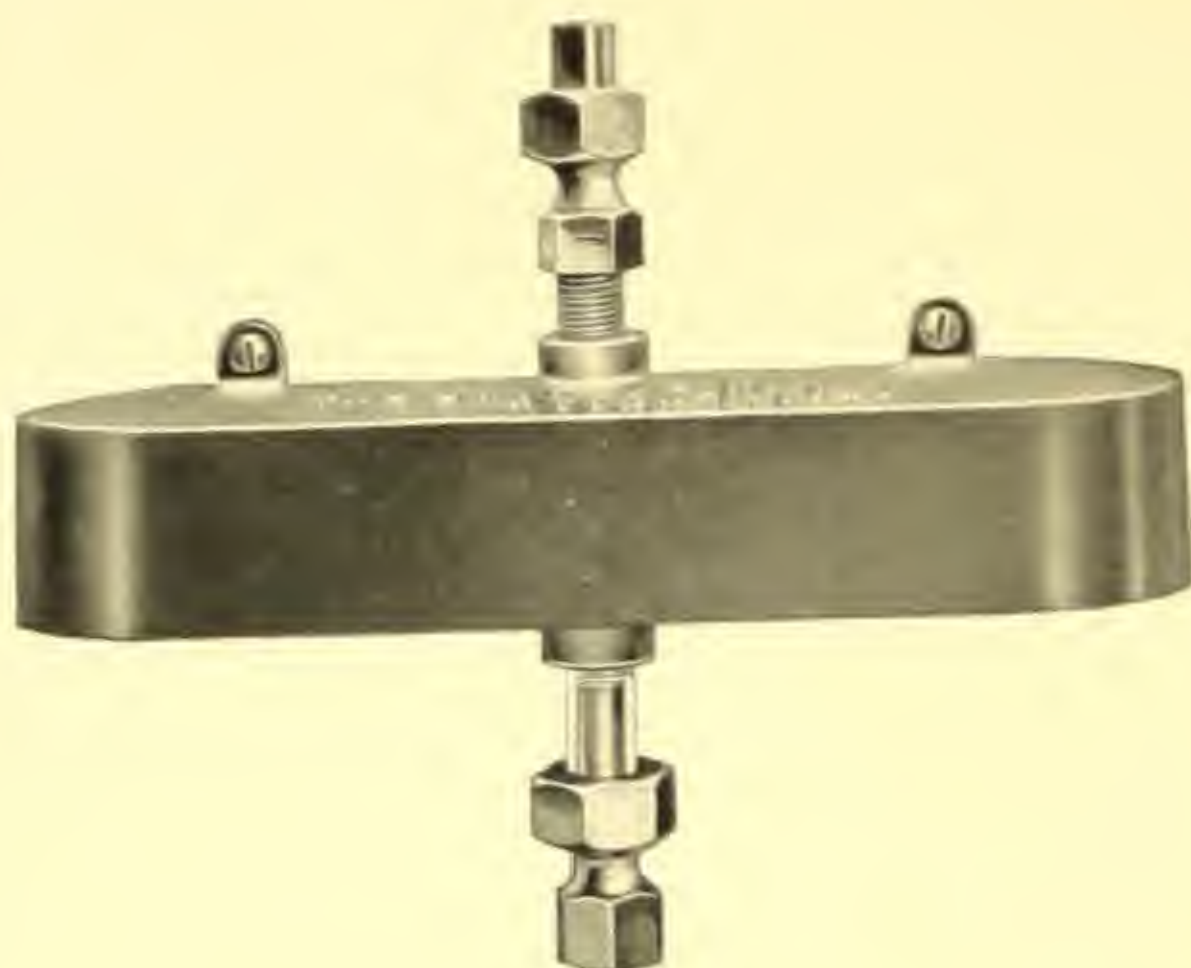


Fig. 622



Fig. 623

### Protection from Chemical Action

When the gauge is used to record pressures of gases or liquids, which contain chemicals injurious to brass or bronze, a Protection Seal should be used.

The seal is placed in the transmission line between the gauge and the pressure-medium, and prevents the injurious substances from coming in actual contact with interior working parts of the instrument, but does not affect the sensitiveness or accuracy.

These seals are filled with oils, chemicals, etc., as required to take care of individual cases.

Protection Seals designed to prevent chemical corrosion are furnished in two types:  
Low Pressure Seal, Fixture No. 32, for pressures up to 10 pounds. List Price, \$17.00

High Pressure Seal, Fixture No. 33, for pressures above 10 pounds. List Price, \$15.00.

### Protection from Hot Steam



Fig. 1907

In using the gauge to record steam pressure the Coil Pipe Syphon Type of Seal should be used to prevent the hot steam from entering interior of instrument. This syphon causes the steam to condense and thus forms a water seal.

The Coil Pipe Syphon, as shown, is complete with lever union cock, which is used to shut off pressure from instrument when desired. The Cock and Syphon are, however, furnished separately.

Coil Pipe Syphon only, Fixture No. 25, as shown in Fig. 1907. List Price, \$1.50.

Lever Union Cock only, suitable for use with Bristol's Recording Gauges, as shown in Fig. 1907. List Price, \$2.00



## NEEDLE VALVES

For Throttling Rapid Fluctuating Pressures



Fig. 1872



Fig. 1873



Fig. 1874

Needle valves are used in the pressure lines to reduce the effect of rapid and excessive pulsations in pressure, in order to secure a more uniform record on the recording instrument. For instance, on the delivery line of pump—in water line—steam line, where steam is drawn off rapidly, etc.

Needle Valve for pressures up to 150 pounds (Fig. 1872). List Price.....\$1.50

Needle Valve for pressures from 150 to 500 pounds (Fig. 1873). List Price....\$3.00

Needle Valve for pressures from 500 to 12,000 pounds (Fig. 1874). List Price, \$12.00

## SOCKET USED WITH NEEDLE VALVE



Fig. 1908

This socket is used to connect the needle valve to gauge. List Price.....\$0.75

## FLEXIBLE CONNECTION



Fig. 1875

line. The connection is 6 inches long and is complete with two unions and a cap plug. List Price.....\$6.00

A Flexible Connection similar in appearance to that shown above is furnished made of helical wound fine copper tubing. The purpose is to reduce rapid pulsations in pressure. It is suitable for use with portable instruments or permanent installations.

Supplied complete with two unions and cap plug. List Price.....\$11.00

This Flexible Connection furnishes a convenient means of connecting the Portable Type of Recording Gauge with the pressure

TEMPERATURE

ELECTRICITY

MOTION ETC



TRADE MARK  
BRISTOL'S  
REG. U. S. PAT. OFFICE

## LONG DISTANCE ELECTRIC TRANSMITTING AND RECORDING SYSTEM

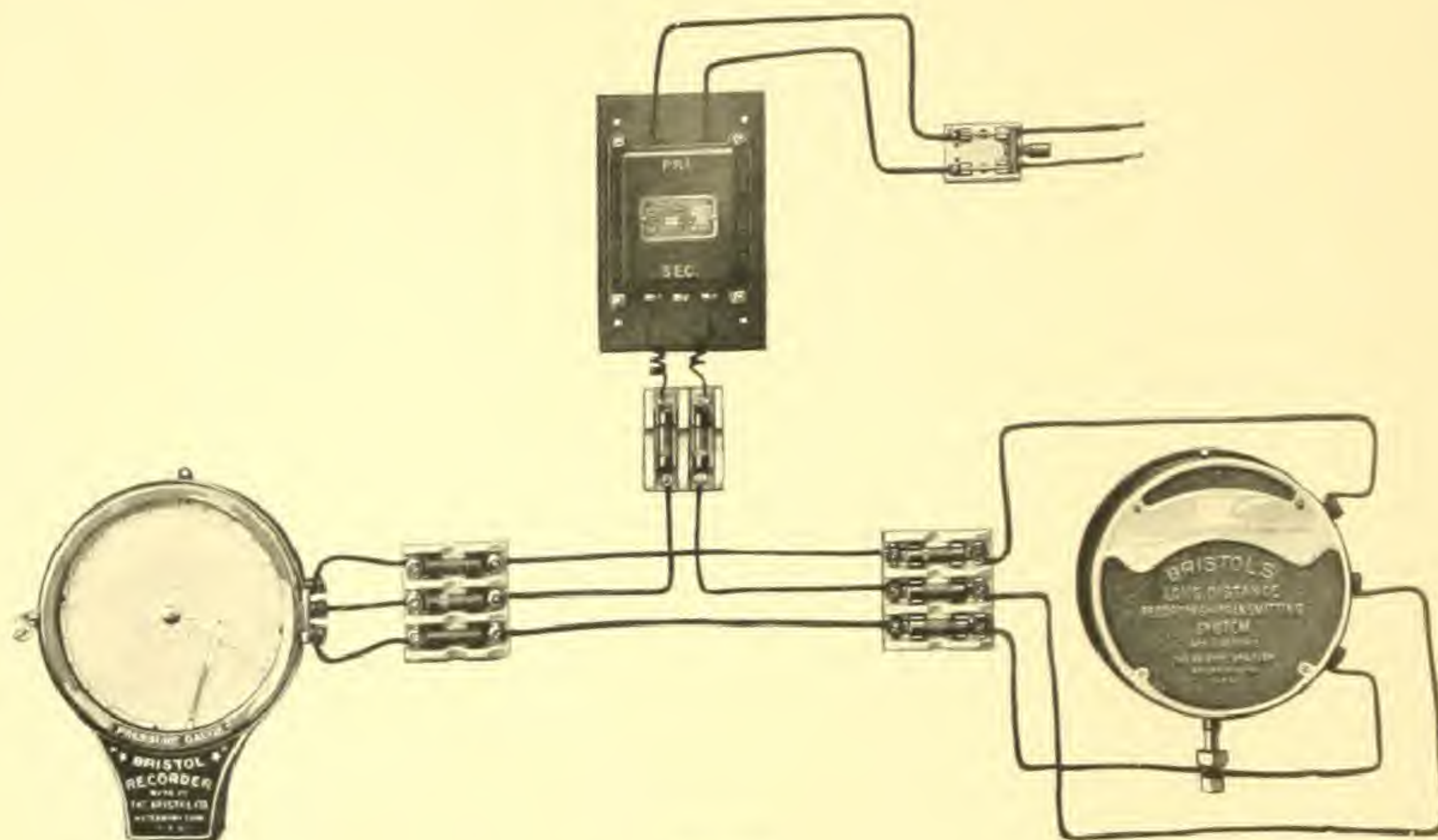


Fig. 1753

Measurements of Pressure, Vacuum and Liquid Level are transmitted over distances of even several miles, with Bristol's Long Distance Electric Transmitting System; thus, making it possible to centralize the information at the point of control.

At the Central Heating Station, where Bristol's Long Distance System is installed, the engineer can tell by looking at the instrument what pressure is actually maintained at the customers' premises, in a distant part of the city. The man in charge at the City Water Works Pumping Station knows what pressure is being carried in the water main several miles from the station. This same engineer can know what the water level is at the reservoir without sending some one to take measurements. At the Gas Works they can tell with Bristol's Long Distance System just what pressures are being main-

tained at different distribution points about the city.

Several hundred of such installations are in actual daily operation. In the City of Detroit, one large central heating plant have over twenty Bristol's Long Distance Systems installed in connection with their heating mains. Government Irrigation Works in the West are using many to transmit records of water level.

Induction balance is the principle on which Bristol's Long Distance Electric Transmitting System operates. There are two instruments employed, the transmitter and receiver. The transmitter actually measures the pressure, vacuum, liquid level, etc., and electrically transmits it to the receiving instrument, which is an electrical duplicate of the transmitter. The receiving instrument indicates or records the units of measure.



TRADE MARK  
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## LONG DISTANCE ELECTRIC TRANSMITTING AND RECORDING SYSTEM

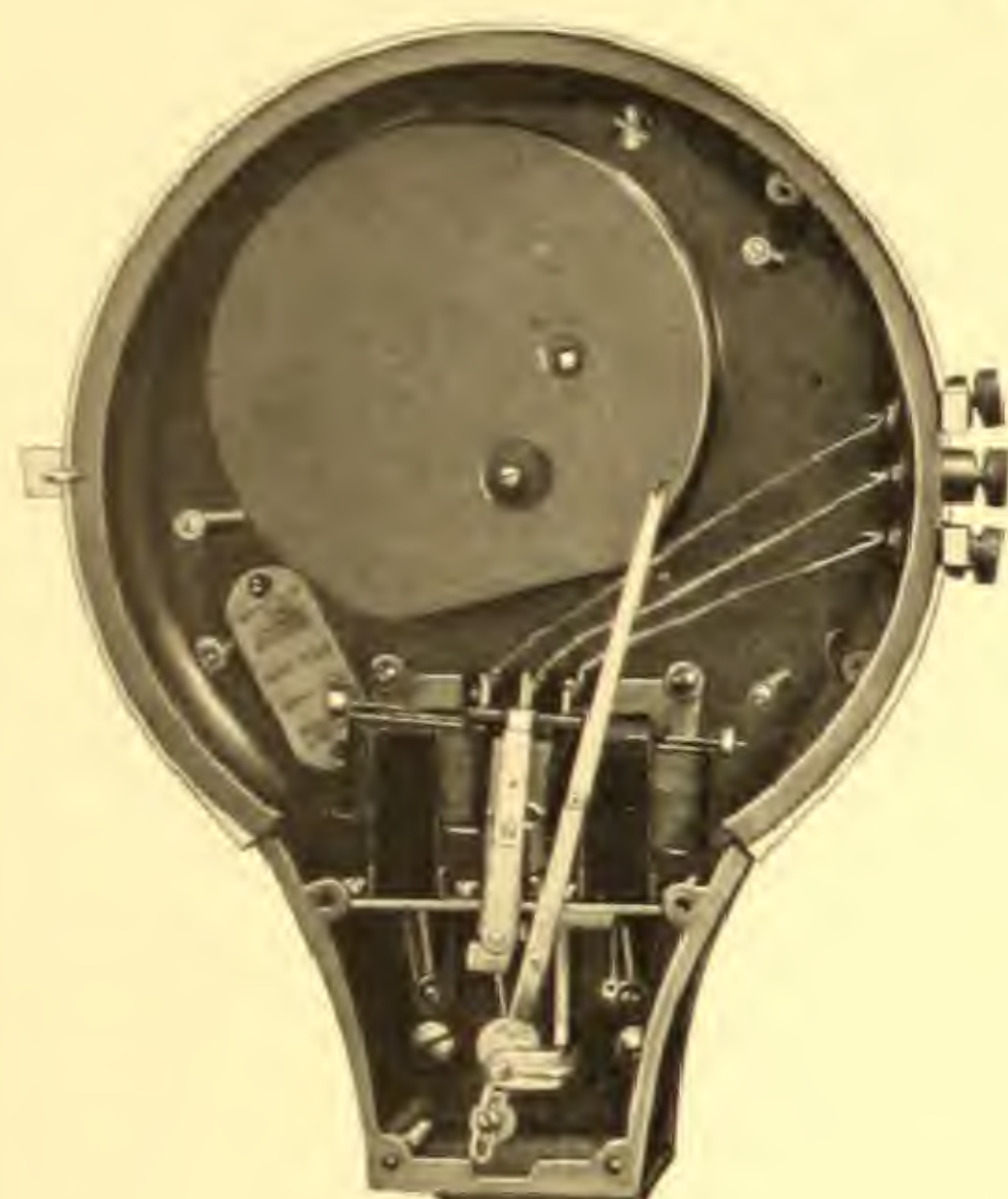


Fig. 1905

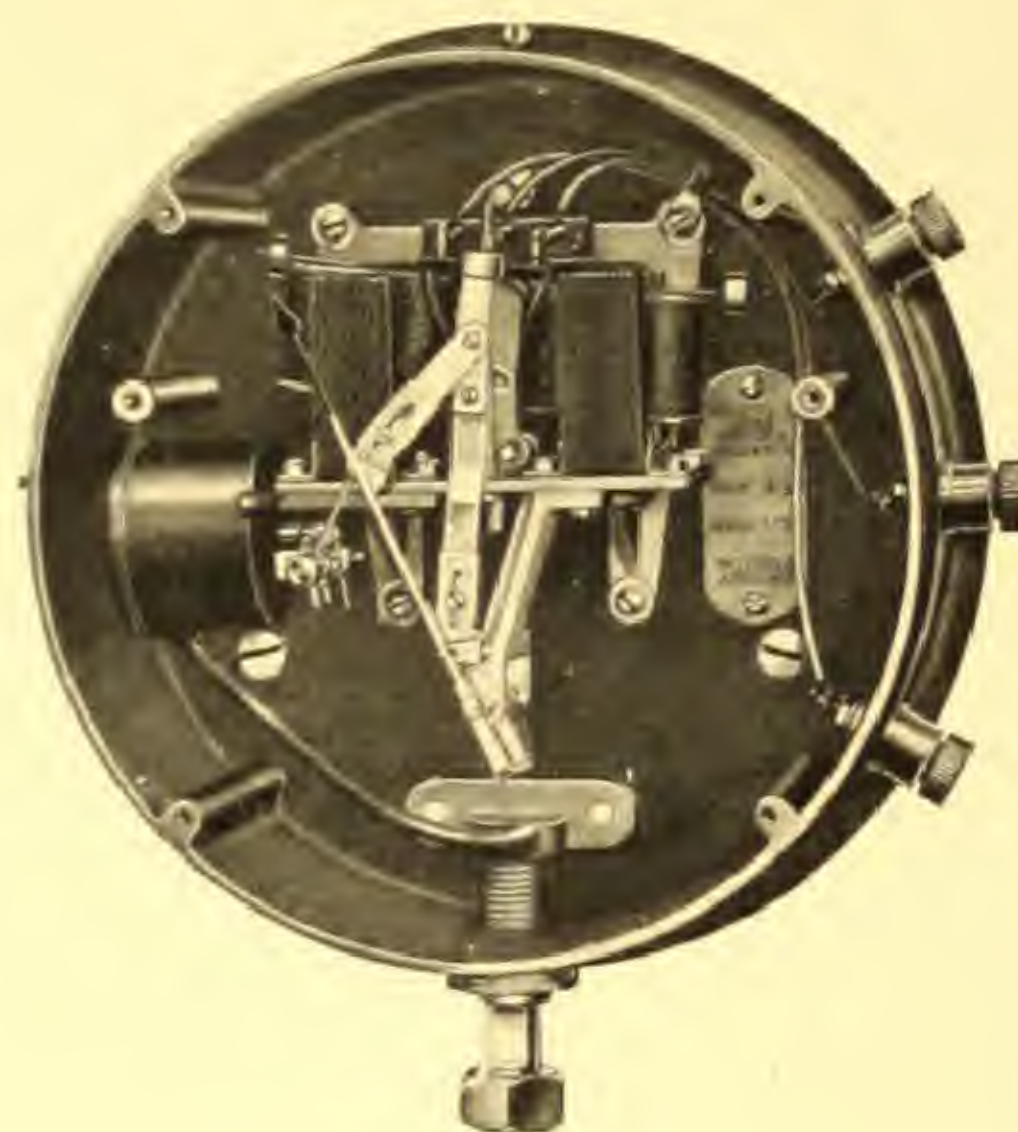


Fig. 1906

Interior construction of the transmitting and receiving instruments are shown in Figs. Nos. 1905 and 1906.

This system is commercially practical, because it is simple and rugged; no delicate jewel bearings or complicated parts to get out of order. Changes in atmospheric

conditions and temperature have very little effect upon the accuracy of the equipment. It is not complicated to install, and can be placed in operation by persons having elementary electrical knowledge.

Quotations sent on request.



Fig. 1793

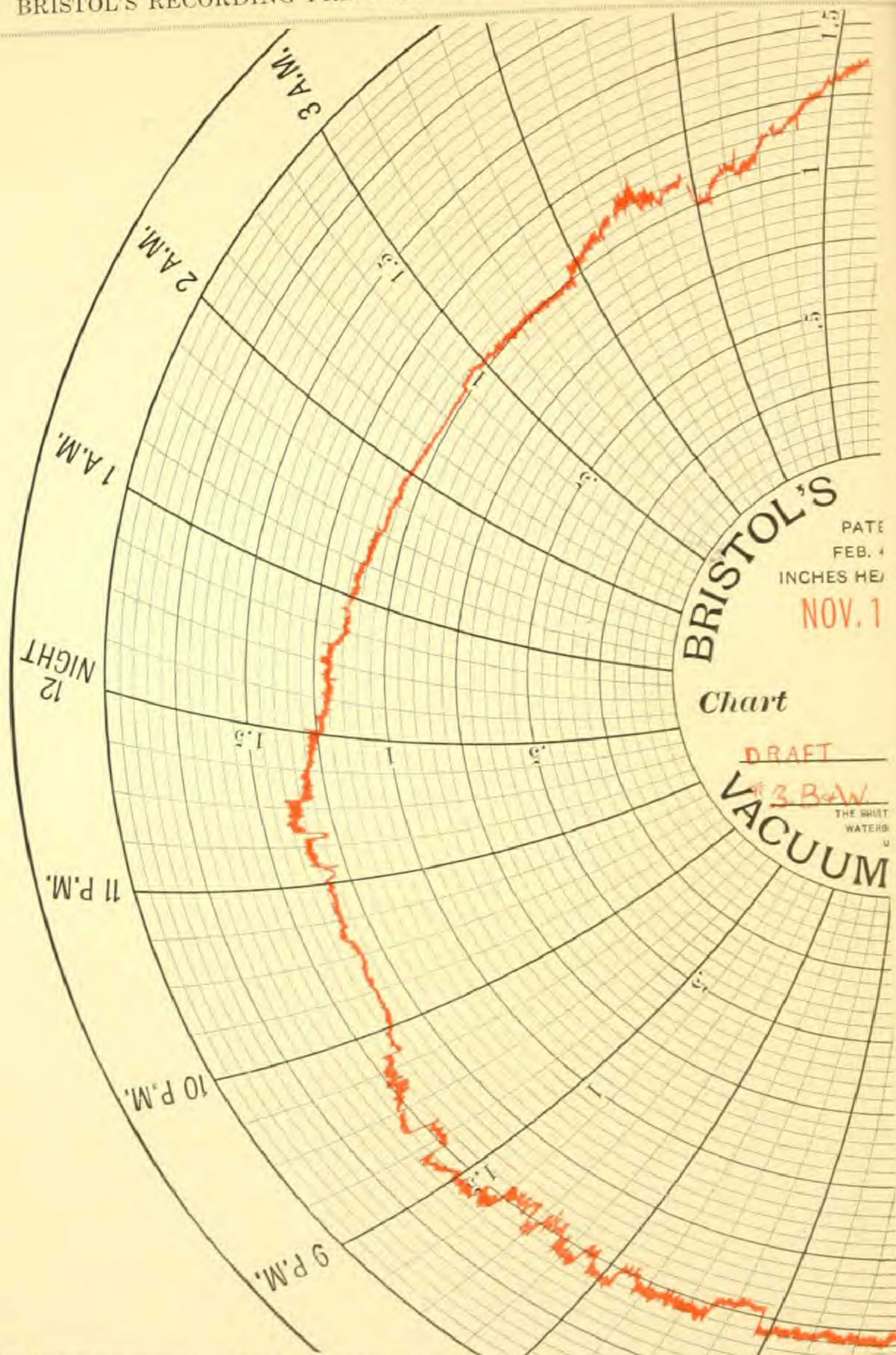


TEMPERATURE

ELECTRICITY

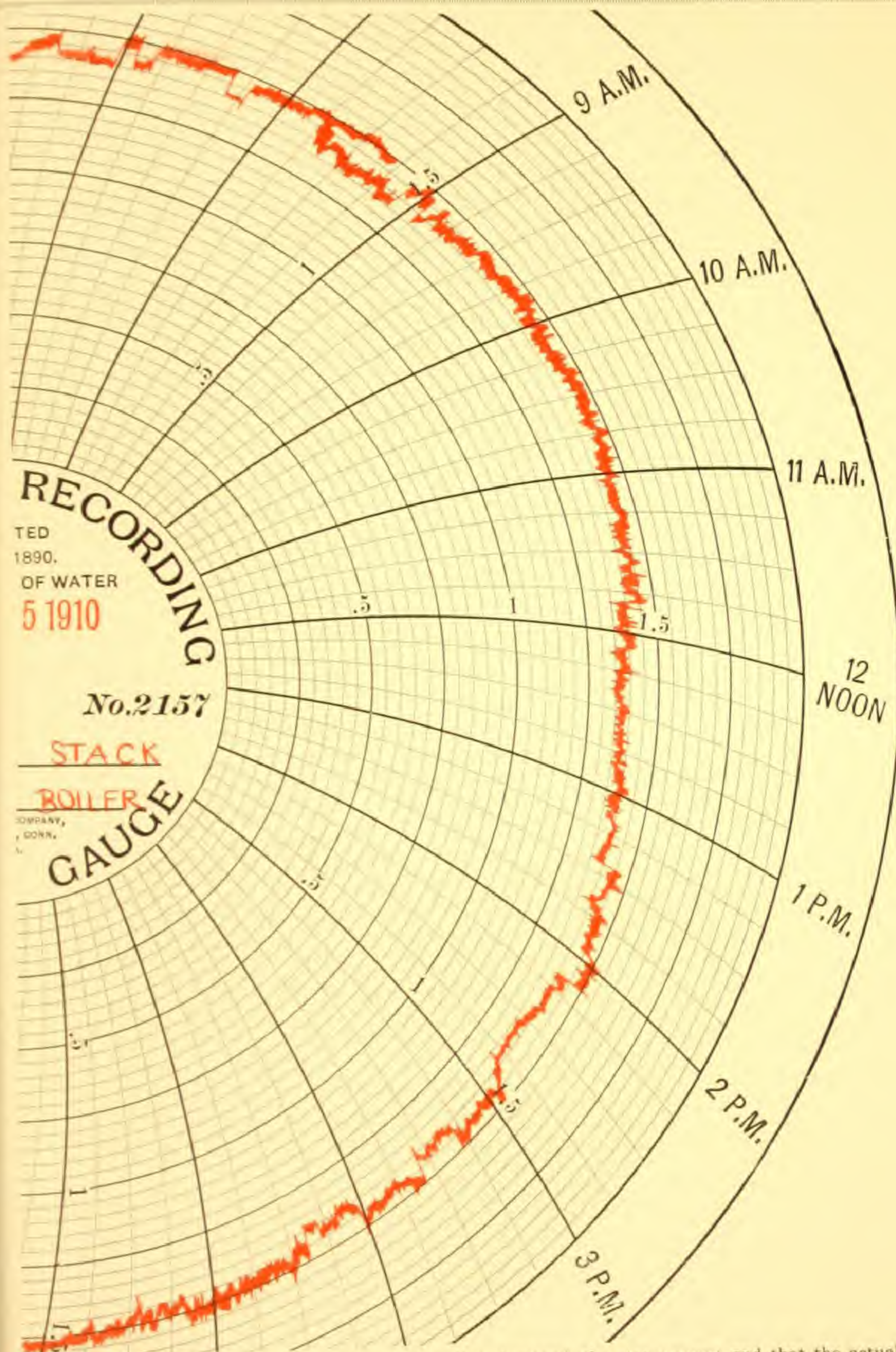
MOTION ETC





Full-size fac-simile sections of 12-inch chart with record of draft (or suction) in stack for B. & W. boiler in power plant of Electric Light and Power Co., as recorded by a Bristol Recording Vacuum (or Draft) Gauge.





It will be noted that the range of this chart is 0 to 2 inches head of water vacuum and that the actual draft as recorded on this chart varies from 1 to 1.6 inches. For list of draft charts see pages 46 and 60.

TEMPERATURE

ELECTRICITY

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# 12-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure
*2037	0 to 6	7 Dys.	
*2188	0 to 6	24 Hrs.	
4633	0 to 10	24 Hrs.	
2244	0 to 12	7 Dys.	
4647	0 to 15	24 Hrs.	
2278	0 to 15 (Reversed)	24 Hrs.	
2340	0 to 20 (Reversed)	24 Hrs.	
2092	0 to 25	7 Dys.	
2240	0 to 25	24 Hrs.	
2147	0 to 25	12 Hrs.	
2006	0 to 32	24 Hrs.	
2230	0 to 50	7 Dys.	
4614	0 to 50	24 Hrs.	
2190	0 to 50 (Reversed)	24 Hrs.	
4636	0 to 60	24 Hrs.	
2146	0 to 75	12 Hrs.	

\* Asterisk refers to List Prices, see page 76.



## 12-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure
2022	0 to 76	7 Dys.	
2352	0 to 80	24 Hrs.	
2108	0 to 80	3 Hrs.	
**2329	35 to 95	12 Hrs.	
2110	0 to 100	7 Dys.	
2165	0 to 100	24 Hrs.	
2197	0 to 100	12 Hrs.	
4660	0 to 100	24 Hrs.	
2212	0 to 100 (Reversed)	12 Hrs.	
*2349	80 to 110	24 Hrs.	
4639	0 to 125	24 Hrs.	
2354	0 to 135	24 Hrs.	
2095	0 to 150	7 Dys.	
2206	0 to 150	24 Hrs.	
†2327	0 to 150	12 Hrs.	
2328	0 to 150	12 Hrs.	
2216	0 to 150	6 Hrs.	
**4624	100 to 160	24 Hrs.	
**2324	100 to 175	24 Hrs.	
2020	0 to 190	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.

† No. 2327, Day Chart; No. 2328, Night Chart.

TEMPERATURE

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## 12-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure	
4640	0 to 200	24 Hrs.		
2043	0 to 210	24 Hrs.		
2016	0 to 230	7 Dys.		
2083	0 to 250	24 Hrs.		
2180	0 to 250	12 Hrs.		
4604	0 to 250	8 Hrs.		
**2377	150 to 250	24 Hrs.		
2259	0 to 300	24 Hrs.		
2024	0 to 350	7 Dys.		
2364	0 to 400	7 Dys.		
2106	0 to 400	24 Hrs.		
2269	0 to 500	7 Dys.		
2395	0 to 500	24 Hrs.		
4653	0 to 500	15 Min.		
2142	0 to 750	24 Hrs.		
2283	0 to 1000	7 Dys.		
2211	0 to 1000	24 Hrs.		

\*\* Asterisks refer to List Prices, see page 76.



## 12-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure
2330	0 to 1800	7 Dys.	
2121	0 to 2000	24 Hrs.	
*2010	0 to 3000	12 Hrs.	
**2311	0 to 4000	24 Hrs.	
**2023	0 to 4000	12 Hrs.	
***2379	2000 to 4000	1 Hr.	
**4616	0 to 5000	12 Hrs.	
***2267	0 to 6000	24 Hrs.	
****2335	0 to 12000	1 Hr.	

## OUNCES PER SQUARE INCH PRESSURE

*2370	0 to 20	7 Dys.	
*2246	0 to 20	24 Hrs.	
*4612	0 to 24	7 Dys.	
*2262	0 to 24	12 Hrs.	

\*, \*\*, \*\*\* and \*\*\*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

MOTION FIT



## 12-INCH CHARTS

### OUNCES PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts	
			Graduations in Ounces per Square Inch Pressure	
*2301	0 to 40	12 Hrs.		
*2245	0 to 48	7 Dys.		
*4611	0 to 64	24 Hrs.		
*2380	0 to 75	7 Dys.		
*2200	0 to 96	24 Hrs.		
*2034	0 to 128	24 Hrs.		

## ATMOSPHERES PRESSURE

2294	0 to 2	24 Hrs.	
2241	0 to 16	12 Hrs.	
2036	0 to 50	24 Hrs.	
2042	0 to 75	24 Hrs.	
2011	0 to 100	24 Hrs.	

\* Asterisk refers to List Prices, see page 76.



## 12-INCH CHARTS

### INCHES HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Pressure
*2357	0 to 2	24 Hrs.	
*2298	0 to 5	7 Dys.	
*2235	0 to 6	24 Hrs.	
*2209 *2355	0 to 8 0 to 8	7 Dys. 24 Hrs.	
*2289 *2268	0 to 8 0 to 8	48 Hrs. 24 Hrs.	
*4718 *2215	0 to 12 0 to 12	7 Dys. 24 Hrs.	
*2368	0 to 30	24 Hrs.	
*2391	0 to 32	24 Hrs.	
*4706 *2257	0 to 40 0 to 40	24 Hrs. 1 Hr.	

\* and \*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

MOTION PICTURE



# 12-INCH CHARTS INCHES HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Pressure	
*4649	0 to 75 (Reversed)	24 Hrs.		
*2302	0 to 120 (Reversed)	24 Hrs.		
*2214	0 to 128	24 Hrs.		
*2181 *4687	0 to 150 0 to 150	7 Dys. 24 Hrs.		

# FEET HEAD OF WATER PRESSURE

2093	0 to 25	7 Dys.		
2124 4731	0 to 30 0 to 30	7 Dys. 24 Hrs.		
2378	0 to 48	24 Hrs.		
**2271	65 to 97	24 Hrs.		
2125	0 to 120	7 Dys.		
2079	0 to 120	24 Hrs.		
2186	0 to 140	12 Hrs.		

\* and \*\* Asterisks refer to List Prices, see page 76.



## 12-INCH CHARTS FEET HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Feet Head of Water Pressure
2300	0 to 150	24 Hrs.	
2293	0 to 190	24 Hrs.	
**2213	150 to 200	24 Hrs.	
2318	0 to 210	24 Hrs.	
2007	0 to 225	7 Dys.	
89	0 to 350	7 Dys.	
96 4709	0 to 500 0 to 500	7 Dys. 24 Hrs.	
2185	0 to 1500	12 Hrs.	

## INCHES HEAD OF MERCURY PRESSURE

*2116	0 to 8	24 Hrs.	
2260	0 to 25	24 Hrs.	

## METRIC UNITS HEAD OF WATER PRESSURE

**2305	0 to 50 Milli- meters	24 Hrs.	
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\* and \*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

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MOTION ETC.



## 12-INCH CHARTS METRIC UNITS HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Metric Units Head of Water Pressure
*2227	0 to 50 Centi-meters	24 Hrs.	
*2276	0 to 126 Centi-meters	24 Hrs.	
**4658	50 to 210 Centi-meters	24 Hrs.	
*2287	0 to 350 Centi-meters	24 Hrs.	
*2052	0 to 30 Deci-meters	12 Hrs.	

## KILOGRAMS PER SQUARE CENTIMETER PRESSURE

2292	0 to 5	7 Dys.	
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## METERS HEAD OF WATER PRESSURE

2375	0 to 75	7 Dys.	
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## INCHES HEAD OF WATER VACUUM

**2157	0 to 2	24 Hrs.	
**2203	0 to 3 (Reversed)	7 Dys.	
*2389	0 to 5	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.



## 12-INCH CHARTS INCHES HEAD OF WATER VACUUM

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Vacuum
*2322	0 to 8	24 Hrs.	
*2390	0 to 30	24 Hrs.	
*2319	0 to 30	12 Hrs.	
*2331	0 to 50	24 Hrs.	
*2394	0 to 60	24 Hrs.	

## MILLIMETERS HEAD OF WATER VACUUM

**2304	0 to 50	24 Hrs.	
*2286	0 to 500	24 Hrs.	

## INCHES HEAD OF MERCURY VACUUM

4705	0 to 20 (Reversed)	24 Hrs.	
2131	0 to 30	7 Dys.	
2151	0 to 30	24 Hrs.	
2148	0 to 30	12 Hrs.	
4797	0 to 30	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

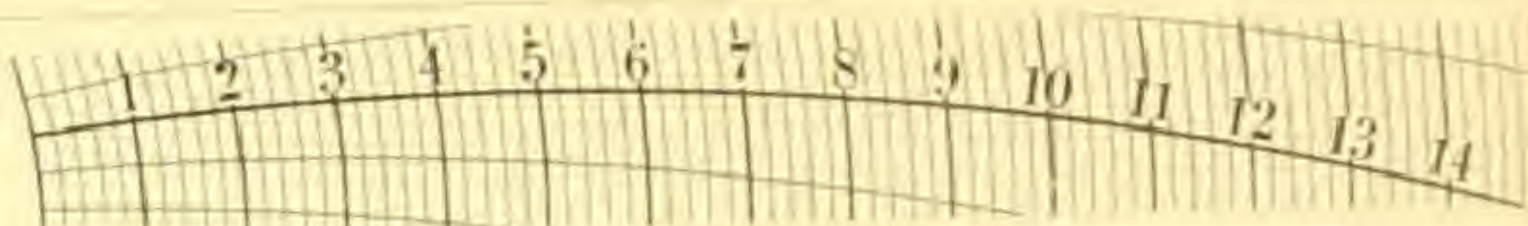
MOTION ETC.



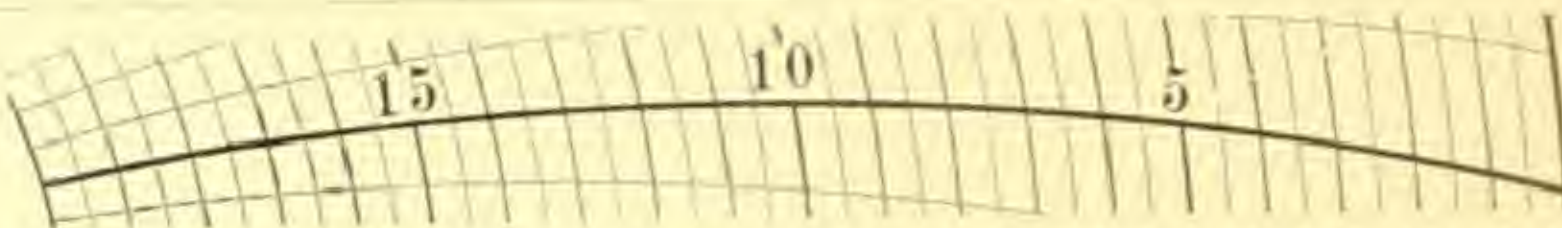
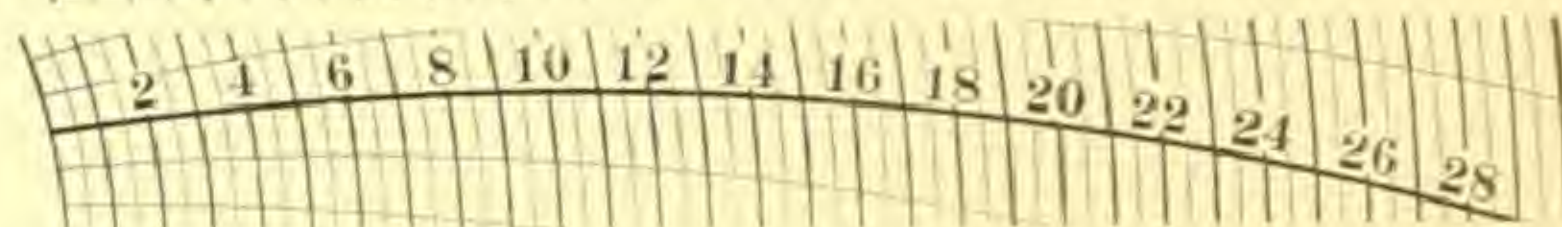
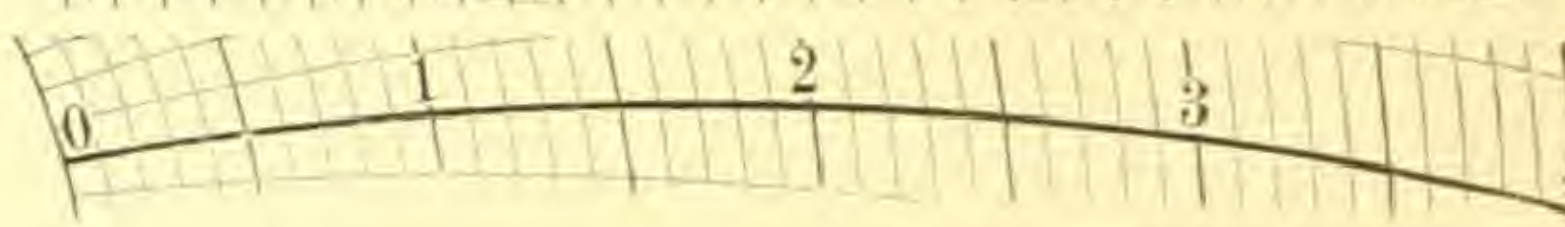
## 12-INCH CHARTS POUNDS PER SQUARE INCH VACUUM

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Vacuum
2087	0 to 15	24 Hrs.	

## RECORDING DRAFT GAUGE CHARTS INCHES HEAD OF WATER VACUUM

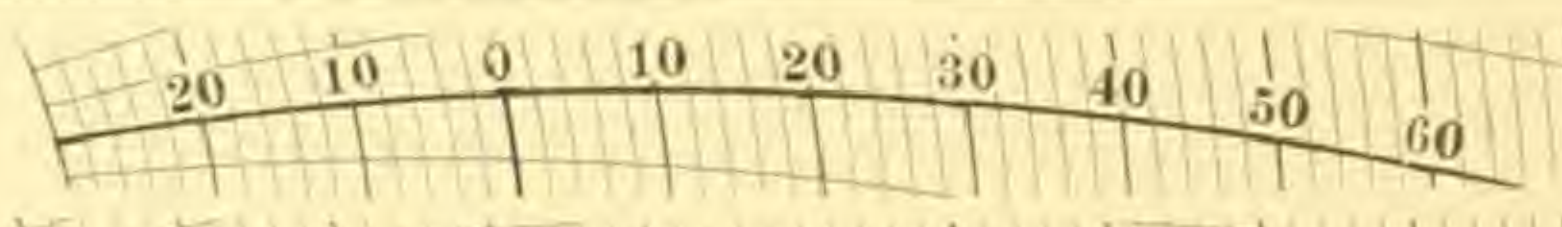
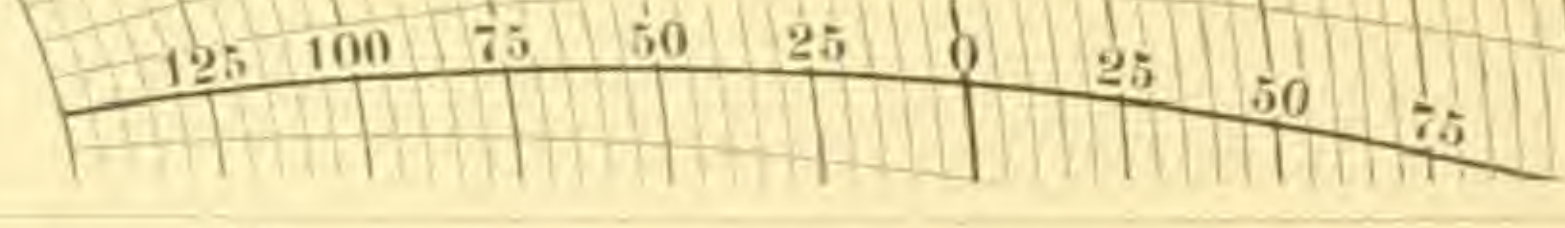
Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Vacuum
**2339	0 to 2 in tenths of inches. Rev. Scale	24 Hrs.	
**2376	0 to 3 in tenths of inches	24 Hrs.	
*2307	0 to 4	24 Hrs.	

## COMBINATION VACUUM AND PRESSURE GAUGE CHARTS

### POUNDS VACUUM AND POUNDS PRESSURE

2168	15 lbs. V. to 50 lbs. P.	7 Dys.	
2225	15 lbs. V. to 160 lbs. P.	12 Hrs.	

### INCHES HEAD OF WATER VACUUM AND INCHES HEAD OF WATER PRESSURE

**2388	.30-0-.70 in hundredths of inches	24 Hrs.	
**2350	1.5-0-1.0 in hundredths of inches	24 Hrs.	

\* and \*\* Asterisks refer to List Prices see page 76.



## 12-INCH CHARTS

### COMBINATION PRESSURE AND VACUUM INCHES HEAD OF WATER VACUUM AND INCHES HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts	
			Graduations in Inches Head of Water Vacuum and Inches Head of Water Pressure	
*2166	1 -0- 4	24 Hrs.		
*2199	5 -0- 5	24 Hrs.		
*2282	6 -0- 6	24 Hrs.		
*2140	2 -0- 8	24 Hrs.		
*2312	4 -0- 8	7 Dys.		
*2143	6 -0- 24	24 Hrs.		
*2303	24 -0- 24	2 Hrs.		
*2399	20 -0- 40	24 Hrs.		
*4605	6 -0- 50	24 Hrs.		
*4662	5 -0-138	24 Hrs.		

\* Asterisk refers to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

MOTION ETC.



## 12-INCH CHARTS

### Combination Pressure and Vacuum

## INCHES HEAD OF MERCURY VACUUM AND POUNDS PRESSURE

Used with Models 11, 12, 40 and 45  
(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts	
			Graduations in Inches Mercury Vacuum and Pounds per Square Inch Pressure	
*4601	5" Mer. V. to 5 lbs. P.	24 Hrs.		
4696	10" Mer. V. to 10 lbs. P.	24 Hrs.		
2204	30" Mer. V. to 15 lbs. P.	7 Dys.		
2017	30" Mer. V. to 15 lbs. P.	24 Hrs.		
2239	30" Mer. V. to 30 lbs. P.	24 Hrs.		
2285	26" Mer. V. to 50 lbs. P.	24 Hrs.		
4747	30" Mer. V. to 50 lbs. P.	7 Dys.		
2386	30" Mer. V. to 50 lbs. P.	24 Hrs.		
**2345	30" Mer. V. to 125 lbs. P.	24 Hrs.		
2359	30" Mer. V. to 150 lbs. P.	24 Hrs.		
2372	25" Mer. V. to 175 lbs. P.	7 Dys.		
2360	30" Mer. V. to 300 lbs. P.	24 Hrs.		

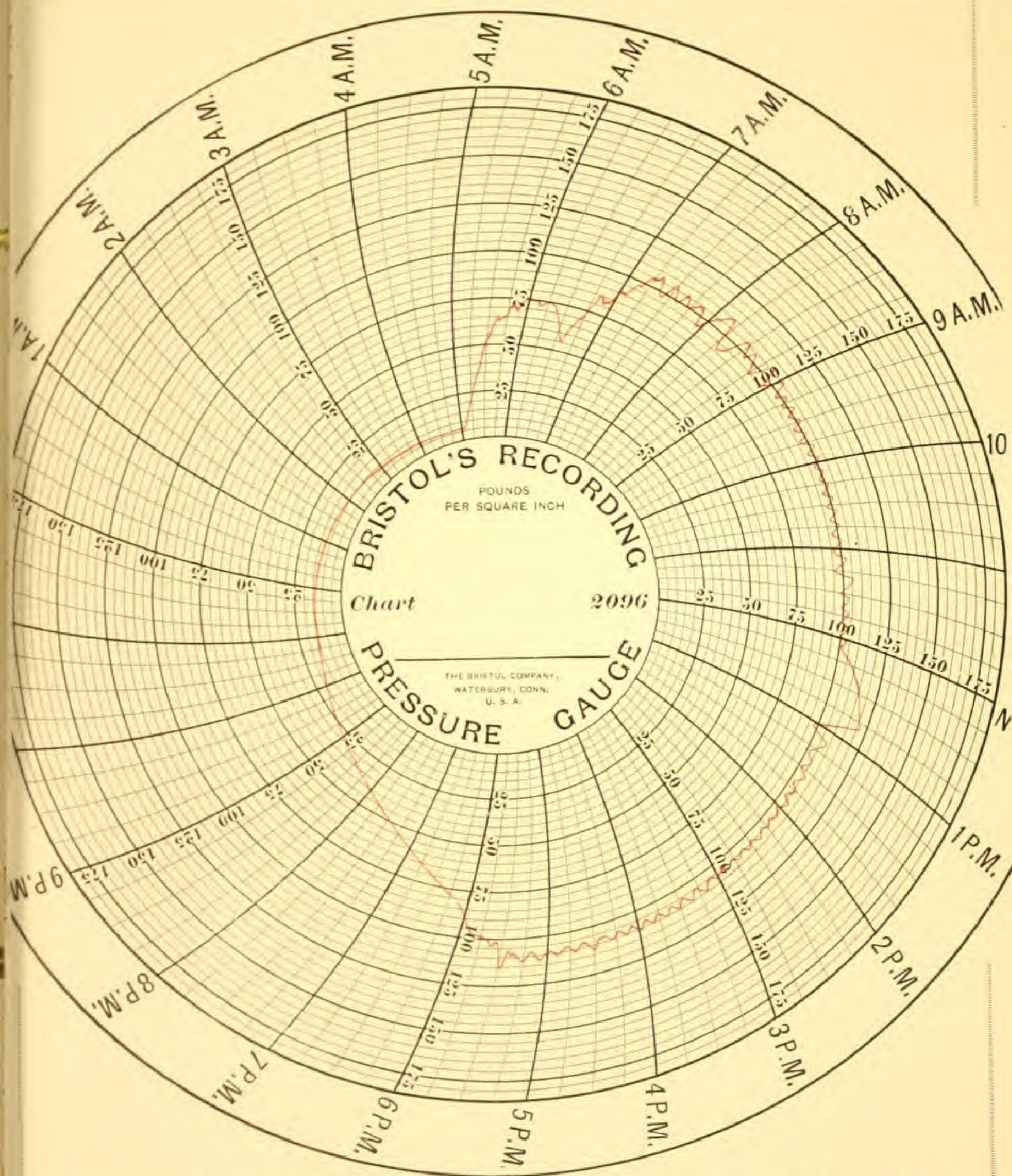
## Combination Vacuum and Pressure Gauges for Ammonia

## INCHES MERCURY VACUUM AND POUNDS PER SQUARE INCH PRESSURE

**2039	30" Mer. V. to 300 lbs. P.	7 Dys.	
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\* and \*\* Asterisks refer to List Prices, see page 76.





Fac-simile Chart No. 2096 with record of steam pressure in boiler of a manufacturing plant. Chart No. 2096 is extensively used for steam pressures. Bristol Recording Gauges have stood the test of years successfully and thousands are now in daily service

TEMPERATURE

ELECTRICITY

MOTION, ETC.



## 8-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure
*2184 *2060	0 to 6 0 to 6	7 Dys. 24 Hrs.	
*2046	0 to 6	24 Hrs.	
*2250	0 to 8	7 Dys.	
2373	0 to 10	24 Hrs.	
2161 91 2018	0 to 12 0 to 12 0 to 12	7 Dys. 24 Hrs. 6 Hrs.	
4634	0 to 15	24 Hrs.	
**2249	14 to 21	24 Hrs.	
94	0 to 25	24 Hrs.	
2080 2218	0 to 30 0 to 30	7 Dys. 24 Hrs.	
4661	0 to 40	24 Hrs.	
4635	0 to 50	24 Hrs.	
2075 2035 2025 2158	0 to 60 0 to 60 0 to 60 0 to 60	7 Dys. 24 Hrs. 12 Hrs. 6 Hrs.	
2145	0 to 70	4 Hrs.	
4637	0 to 80	24 Hrs.	
**2254	20 to 90	24 Hrs.	
2068 81 2261	0 to 94 0 to 94 0 to 94	7 Dys. 24 Hrs. 1 Hr.	

\* and \*\* Asterisks refer to List Prices, see page 76.



## 8-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure
4686	0 to 100	7 Dys.	
4638	0 to 100	24 Hrs.	
**2252	40 to 100	24 Hrs.	
2173	0 to 125	24 Hrs.	
**2134	60 to 125	24 Hrs.	
2081	0 to 150	24 Hrs.	
2351	0 to 150	7 Dys.	
2308	0 to 150	12 Hrs.	
2320	0 to 150	6 Hrs.	
**2310	75 to 150	24 Hrs.	
**2242	100 to 160	24 Hrs.	
2096	0 to 185	24 Hrs.	
4600	0 to 185	3 Hrs.	
2363	0 to 185	1 Hr.	
4641	0 to 200	24 Hrs.	
**2167	100 to 200	24 Hrs.	
2033	0 to 210	7 Dys.	
35	0 to 210	24 Hrs.	
45	0 to 210	1 Hr.	
4615	0 to 225	24 Hrs.	
2026	0 to 225	12 Hrs.	
2038	0 to 240	7 Dys.	
2172	0 to 250	24 Hrs.	

\*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY


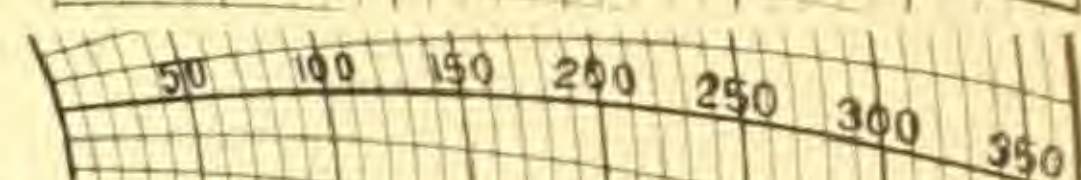

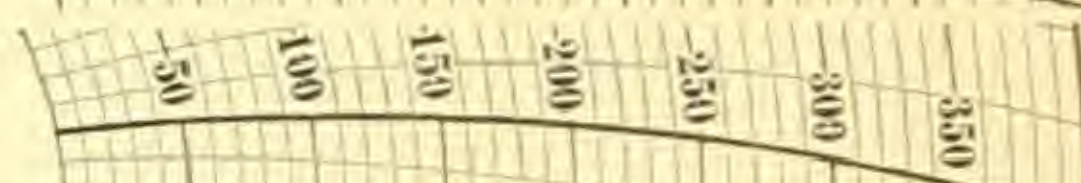

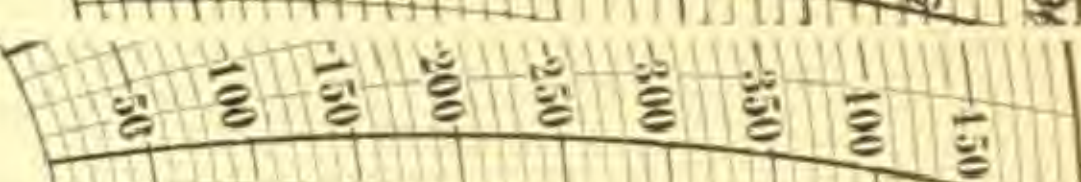
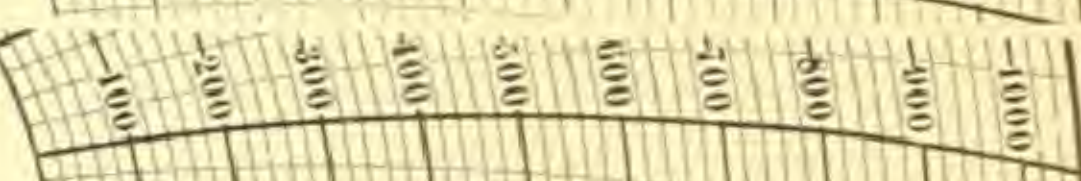
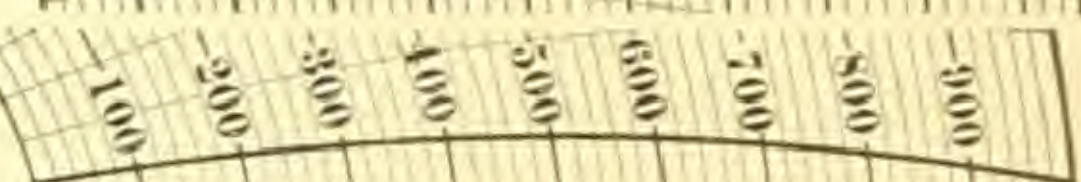
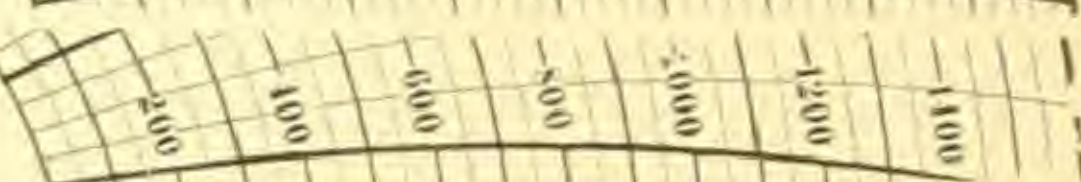

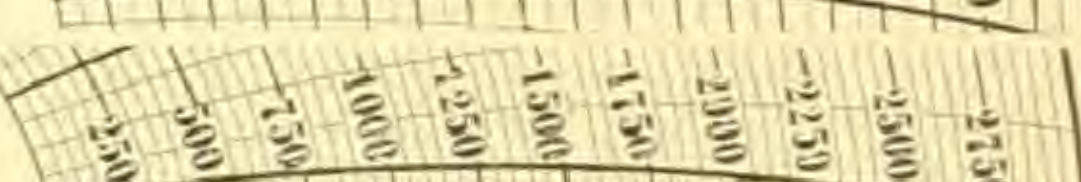
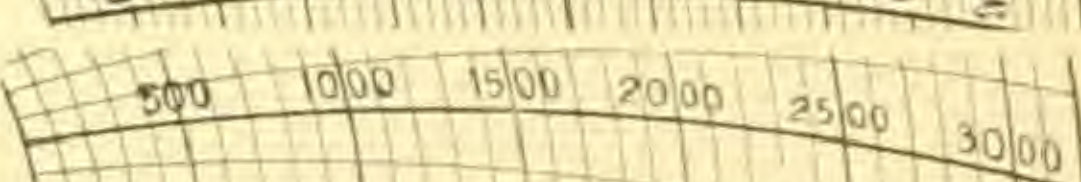
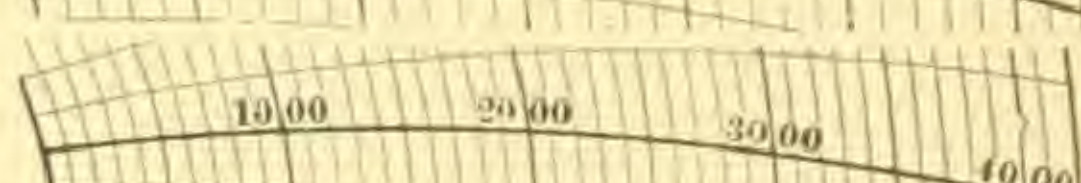



MOTION, ETC.



# 8-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure
4654 4642	0 to 300	7 Dys. 24 Hrs.	
30	0 to 360	24 Hrs.	
2050	0 to 360	6 Hrs.	
4643	0 to 400	24 Hrs.	
44	0 to 410	24 Hrs.	
4685 4644	0 to 500	7 Dys. 24 Hrs.	
2192	0 to 1000	24 Hrs.	
2222	0 to 1000	1 Hr.	
2356 2132	0 to 1600	24 Hrs. 6 Hrs.	
2397	0 to 2000	24 Hrs.	
*4665	0 to 3000	24 Hrs.	
*4613 *38	0 to 3200	7 Dys. 24 Hrs.	
**2003 **86 **2056	0 to 4000	12 Hrs. 6 Hrs. 3 Hrs.	
**4631	0 to 4000	8 Hrs.	
***2332	0 to 6000	7 Dys.	
***2078	0 to 6000	24 Hrs.	

\*, \*\*, \*\*\* Asterisks refer to List Prices, see page 76.



## 8-INCH CHARTS POUNDS PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Pounds per Square Inch Pressure
****2019	0 to 10000	24 Hrs.	
****2044	0 to 10000	12 Hrs.	
****4650	0 to 10000	6 Hrs.	
***2162	0 to 12000	5 Min.	

## TONS PRESSURE; FOR HYDRAULIC PRESSES

**2118	0 to 135 On 9-In. Ram	24 Hrs.	
**2123	0 to 150	6 Hrs.	
**4607	0 to 180 On 9 1/2-In. Ram 0 to 5079 Pounds	24 Hrs.	
**2130	0 to 200 On 9-In. Ram	12 Hrs.	
**2141	0 to 200 On 10-In. Ram	12 Hrs.	
**2077	0 to 200	10 Hrs.	
**2063	0 to 200 On 10-In. Ram	15 Min.	
**2062	0 to 225	3 Hrs.	
**2344	0 to 350 On 9-In. Ram	10 Hrs.	
**2341	0 to 350 On 10-In. Ram	10 Hrs.	
**2065	0 to 470	24 Hrs.	
**2066	0 to 470	12 Hrs.	
**4663	0 to 500	24 Hrs.	

## OUNCES PER SQUARE INCH PRESSURE

*2149	0 to 5	24 Hrs.	
*4618	0 to 8	7 Dys.	
*4751	0 to 8	24 Hrs.	
*2296	0 to 12	7 Dys.	
*2337	0 to 12	72 Hrs.	

\*, \*\*, \*\*\*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



## 8-INCH CHARTS

### OUNCES PER SQUARE INCH PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Ounces per Square Inch Pressure
*4621 *2113	0 to 20 0 to 20	24 Hrs. 12 Hrs.	
*2272	0 to 24	7 Dys.	
*2316	0 to 25	24 Hrs.	
*2086	0 to 32	9 Hrs.	
*2306	0 to 35	24 Hrs.	
*2153 *2152	0 to 48 0 to 48	7 Dys. 24 Hrs.	
*2094	0 to 63	24 Hrs.	

## INCHES HEAD OF MERCURY PRESSURE

*2398	0 to 2	24 Hrs.	
*2137	0 to 5	24 Hrs.	
*4726 *2156	0 to 12 0 to 12	7 Dys. 24 Hrs.	
4629	0 to 20	24 Hrs.	
2265	0 to 30	24 Hrs.	
**4627	25 to 83	24 Hrs.	
**4646	30 to 90	7 Dys.	

\* and \*\* Asterisks refer to List Prices, see page 76.



## 8-INCH CHARTS INCHES HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Pressure
**2315	0 to 1 (Reversed)	24 Hrs.	
**2201	0 to 1.5	24 Hrs.	
*2076 *2064	0 to 4 0 to 4	48 Hrs. 24 Hrs.	
*2170	0 to 5	24 Hrs.	
*2090 *2187	0 to 6 0 to 6	24 Hrs. 12 Hrs.	
*2126 *2059	0 to 8 0 to 8	7 Dys. 24 Hrs.	
*2251 *2091	0 to 12 0 to 12	7 Dys. 24 Hrs.	
*2182 *2238	0 to 15 0 to 15	7 Dys. 24 Hrs.	
*4645	0 to 24	7 Dys.	
*2109	0 to 24	24 Hrs.	
*2232 †*2325 *2326	0 to 35 0 to 35 0 to 35	24 Hrs. 12 Hrs. 12 Hrs.	
*2160	0 to 50	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.  
† No. 2325, Day Chart. No. 2326, Night Chart.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



## 8-INCH CHARTS

### INCHES HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Pressure
*4757 *2117	0 to 60 0 to 60	7 Dys. 24 Hrs.	
*2163	0 to 75	24 Hrs.	
*2387	0 to 105	7 Dys.	
*2139	0 to 110	24 Hrs.	
*4648	0 to 150	24 Hrs.	

## FEET HEAD OF WATER PRESSURE

*2288	0 to 10	24 Hrs.	
**2178	12 to 17	24 Hrs.	
*2004	0 to 20 (Reversed)	24 Hrs.	
2032	0 to 25	24 Hrs.	
2005	0 to 58	24 Hrs.	
2396	0 to 60	7 Dys.	
**2128	25 to 83	24 Hrs.	
2174 92	0 to 105 0 to 105	7 Dys. 24 Hrs.	
**2135	60 to 125	24 Hrs.	
2290	0 to 138	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.



## 8-INCH CHARTS FEET HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Feet Head of Water Pressure
2164	0 to 210	7 Dys.	
82	0 to 210	24 Hrs.	
4608	0 to 240	7 Dys.	
**2361	150 to 300	24 Hrs.	
77	0 to 320	24 Hrs.	
78	0 to 420	24 Hrs.	
4632	0 to 600	7 Dys.	
4700 2207	0 to 800 0 to 800	7 Dys. 24 Hrs.	

## KILOGRAMS PER SQUARE CENTIMETER PRESSURE

97	0 to .84 Kilograms	24 Hrs.	
98	0 to 3.1 Kilograms	24 Hrs.	
99	0 to 13 Kilograms	24 Hrs.	
2028	0 to 17 Kilograms	24 Hrs.	
2002	0 to 74 Kilograms	24 Hrs.	
4626	0 to 450 Kilograms	24 Hrs.	

\*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



# 8-INCH CHARTS MILLIMETERS AND CENTIMETERS HEAD OF MERCURY PRESSURE

Used with Models 11, 12, 40 and 45  
(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Millimeters and Centimeters Head of Mercury Pressure
*2266	0 to 100 Millimeters	24 Hrs.	
*2264	0 to 150 Millimeters	24 Hrs.	
*4630	0 to 500 Millimeters	24 Hrs.	
*2221	0 to 1000 Millimeters	24 Hrs.	
*2085	0 to 30 Centimeters	24 Hrs.	
*2281	0 to 50 Centimeters	24 Hrs.	
*2097	0 to 100 Centimeters	24 Hrs.	

# MILLIMETERS AND CENTIMETERS HEAD OF WATER PRESSURE

*2274	0 to 200 Millimeters	24 Hrs.	
*2275	0 to 300 Millimeters	24 Hrs.	
*2369	0 to 375 Millimeters	24 Hrs.	
*4628	0 to 900 Millimeters	24 Hrs.	
*2233	0 to 1000 Millimeters	24 Hrs.	
*4652	0 to 10 Centimeters	7 Dys.	
*2226	0 to 16 Centimeters	24 Hrs.	
*4659	0 to 100 Centimeters	24 Hrs.	

\* Asterisk refer to List Prices, see page 76.



# 8-INCH CHARTS CENTIMETERS AND METERS HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45  
(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Centimeters and Meters Head of Water Pressure
*2175	0 to 250 Centimeters	24 Hrs.	
*2229	0 to 425 Centimeters	24 Hrs.	
2228	0 to 45 Meters	24 Hrs.	
2371	0 to 90 Meters	24 Hrs.	

## MILLIMETERS HEAD OF KEROSENE PRESSURE

**2210	0 to 100 Millimeters Kerosene	24 Hrs.	
**4620	100 to 200 Millimeters Kerosene	24 Hrs.	

## CENTIMETERS HEAD OF KEROSENE PRESSURE

*4617	0 to 16 Centimeters Kerosene	24 Hrs.	
*2321	0 to 100 Centimeters Kerosene	24 Hrs.	

## ATMOSPHERES PRESSURE

87	0 to 2	24 Hrs.	
2297	0 to 6	7 Dys.	
4622	0 to 6	12 Hrs.	
84	0 to 6	24 Hrs.	
73	0 to 9	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

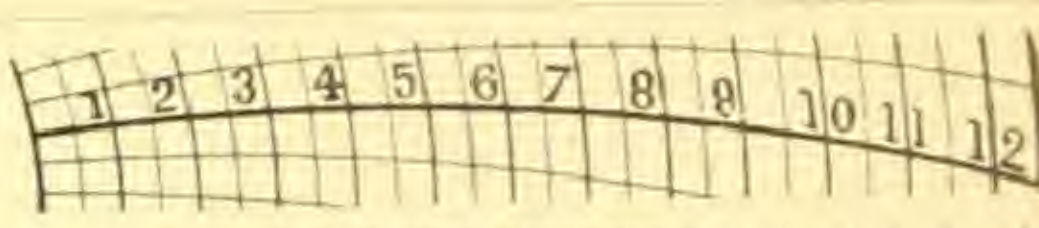
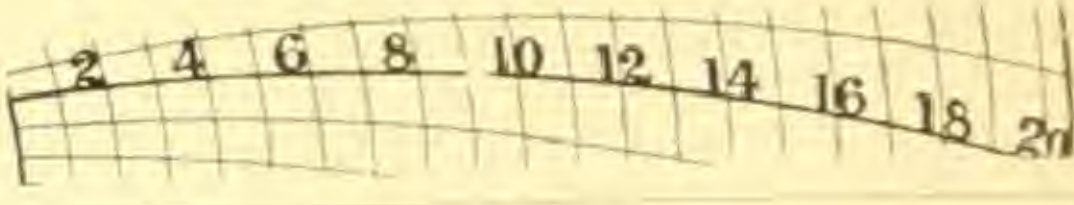
MOTION, ETC.



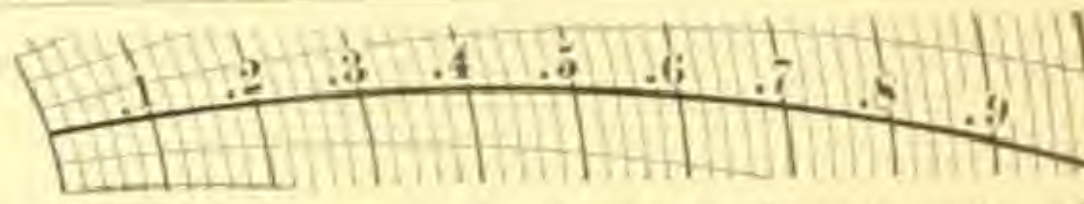
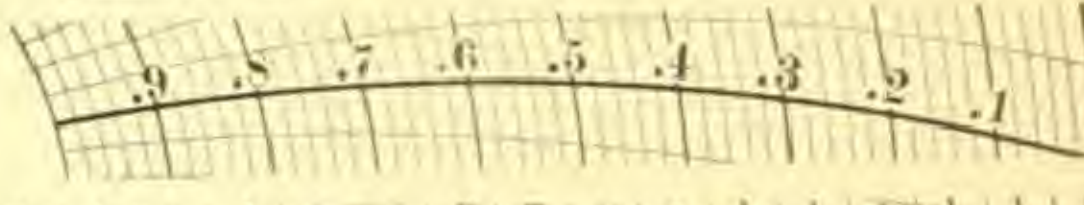
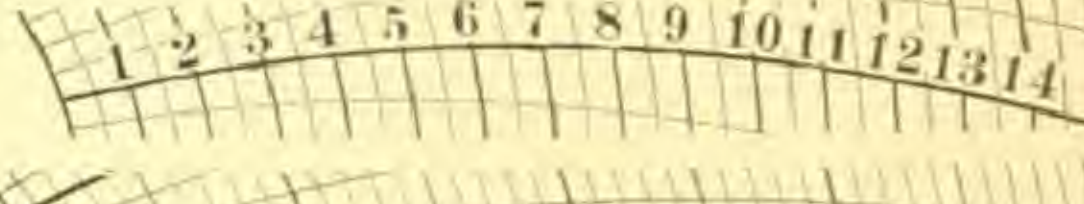


## 8-INCH CHARTS ATMOSPHERES PRESSURE

Used with Models 11, 12, 40 and 45



(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Atmospheres Pressure
79	0 to 12	24 Hrs.	
27	0 to 20	24 Hrs.	

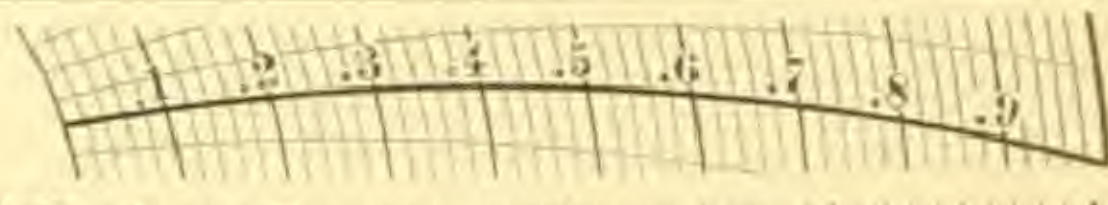
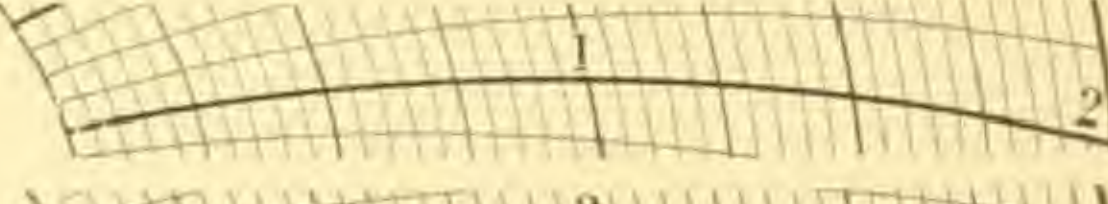

## INCHES HEAD OF WATER VACUUM DRAFT

**2231	0 to 1	24 Hrs.	
**2219	0 to 1 (Reversed)	24 Hrs.	
**2347	0 to 1.5 Graduated in Tenths	24 Hrs.	
**2194	0 to 2	24 Hrs.	
**2243	0 to 2 1/2	24 Hrs.	

## MILLIMETERS HEAD OF WATER VACUUM DRAFT

**4651	0 to 25	7 Dys.	
**4603	0 to 25	24 Hrs.	

## INCHES HEAD OF WATER VACUUM

**2234	0 to 1	24 Hrs.	
**2088	0 to 2	24 Hrs.	
*2100 *2103	0 to 4 0 to 4	7 Dys. 24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.



## 8-INCH CHARTS INCHES HEAD OF WATER VACUUM

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Vacuum
*2338	0 to 5	24 Hrs.	
*2353	0 to 6	24 Hrs.	
*2105	0 to 6	12 Hrs.	
*2102	0 to 8	24 Hrs.	
*2101	0 to 12	24 Hrs.	
*4602	0 to 35	24 Hrs.	
*2179	0 to 60	24 Hrs.	
*2171	0 to 120	24 Hrs.	

## FEET HEAD OF WATER VACUUM

2155	0 to 35	24 Hrs.	
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## INCHES HEAD OF MERCURY VACUUM

*2358	0 to 10	7 Dys.	
*2176	0 to 10	24 Hrs.	
2120	0 to 30	7 Dys.	
93	0 to 30	24 Hrs.	
2198	0 to 30	1 Hr.	
2348	0 to 30 (Reversed)	8 Hrs.	

## MILLIMETERS HEAD OF WATER VACUUM

**2119	0 to 50 Millimeters	24 Hrs.	
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\* and \*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



## 8-INCH CHARTS MILLIMETERS HEAD OF WATER VACUUM

Used with Models 11, 12, 40 and 45  
(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Millimeters Head of Water Vacuum
*2393	0 to 300 Millimeters	24 Hrs.	
*2273	0 to 750 Millimeters	24 Hrs.	

## CENTIMETERS HEAD OF WATER VACUUM

*2144	0 to 50 Centimeters	24 Hrs.	
*2053	0 to 100 Centimeters	24 Hrs.	

## CENTIMETERS HEAD OF MERCURY VACUUM

2295	0 to 75	24 Hrs.	
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## Combination Vacuum And Pressure POUNDS PER SQUARE INCH VACUUM AND POUNDS PER SQUARE INCH PRESSURE

4619	15 V. to 40 P.	7 Dys.	
2013	15 V. to 40 P.	24 Hrs.	
2299	15 V. to 50 P.	24 Hrs.	
2279	10 V. to 60 P.	7 Dys.	
**4610	5 V. to 100 P.	24 Hrs.	
2258	15 V. to 200 P. (Reversed)	24 Hrs.	

## OUNCES VACUUM AND OUNCES PRESSURE

*2057	4 V. to 10 P.	24 Hrs.	
*2317	16 V. to 16 P.	24 Hrs.	

\* and \*\* Asterisk refers to List Prices, see page 76.



**8-INCH CHARTS**  
**Combination Pressure and Vacuum**  
**INCHES MERCURY VACUUM AND POUNDS PRESSURE**

Used with Models 11, 12, 40 and 45  
(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Mercury Vacuum and Pounds per Square Inch Pressure
2270	15" M. V. to 5 Lbs. P.	24 Hrs.	
4708 2048	30" M. V. to 6 Lbs. P.	7 Dys. 24 Hrs.	
2098 2236	15" M. V. to 10 Lbs. P.	7 Dys. 24 Hrs.	
4606	30" M. V. to 15 Lbs. P.	7 Dys.	
4735 2009 2014	30" M. V. to 15 Lbs. P.	7 Dys. 24 Hrs. 12 Hrs.	
2313	30" M. V. to 30 Lbs. P.	24 Hrs.	
4671	30" M. V. to 50 Lbs. P.	7 Dys.	
54	30" M. V. to 50 Lbs. P. (Reversed)	24 Hrs.	
**2333	30" M. V. to 100 Lbs. P.	24 Hrs.	
2336	30" M. V. to 150 Lbs. P.	24 Hrs.	
**2255	30" M. V. to 250 Lbs. P.	24 Hrs.	
2205	30" M. V. to 300 Lbs. P.	24 Hrs.	
**2256	30" M. V. to 400 Lbs. P.	24 Hrs.	

\*\* Asterisks refer to List Prices, see page 76.

TEMPERATURE

ELECTRICITY



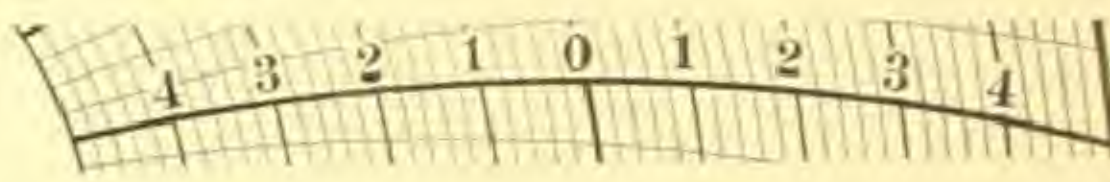




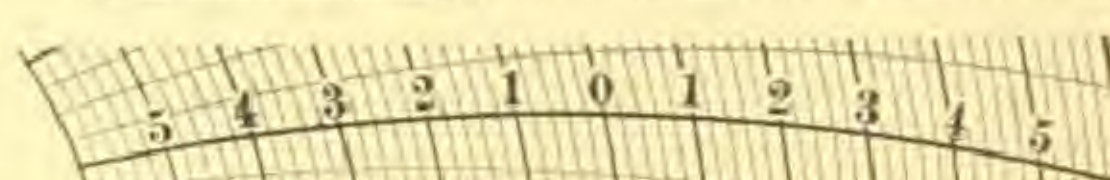
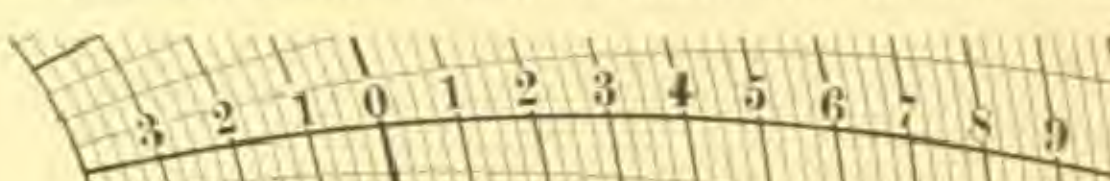
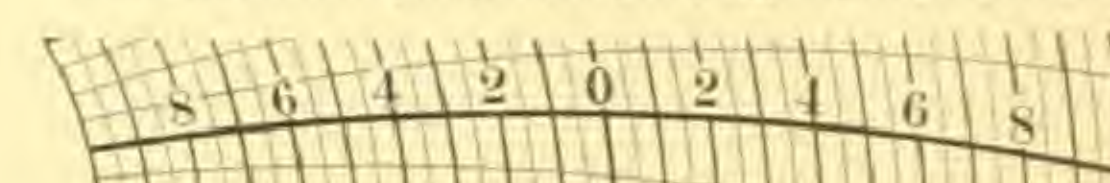


MOTION, ETC.



# 8-INCH CHARTS Combination Pressure and Vacuum INCHES HEAD OF WATER VACUUM AND INCHES HEAD OF WATER PRESSURE

Used with Models 11, 12, 40 and 45

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Vacuum and Inches Head of Water Pressure
**2217	2½" V. to ½" P.	24 Hrs.	
**4711	1" V. to ½" P. Graduated in Tenths	24 Hrs.	
**2362	½" V. to ½" P. Graduated in Tenths	24 Hrs.	
**2334	1" V. to 1" P. Graduated in Hundredths	24 Hrs.	
**2061 **2082	1" V. to 2" P. 1" V. to 2" P.	24 Hrs. 1 Hr.	
*2049	3" V. to 3" P.	24 Hrs.	
*2067 *2058	4" V. to 4" P. 4" V. to 4" P.	7 Dys. 24 Hrs.	
*2112 *2223	6" V. to 6" P. 6" V. to 6" P.	24 Hrs. 1 Hr.	
*2115	4" V. to 10" P.	24 Hrs.	
*4664	10" V. to 10" P.	24 Hrs.	
*2159	2" V. to 15" P.	24 Hrs.	
*2343	5" V. to 20" P.	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see page 76.

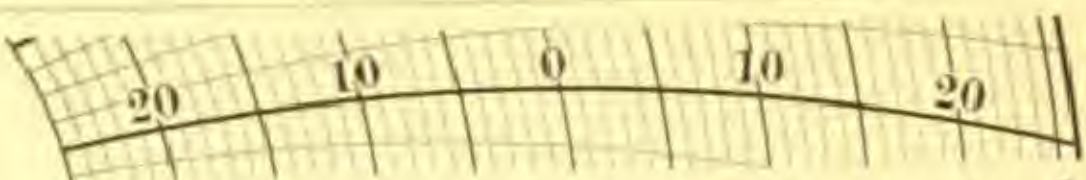
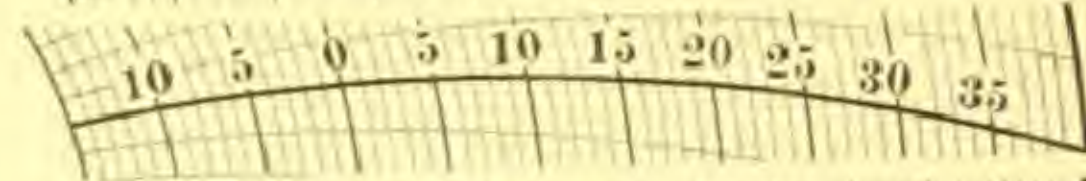



**8-INCH CHARTS**

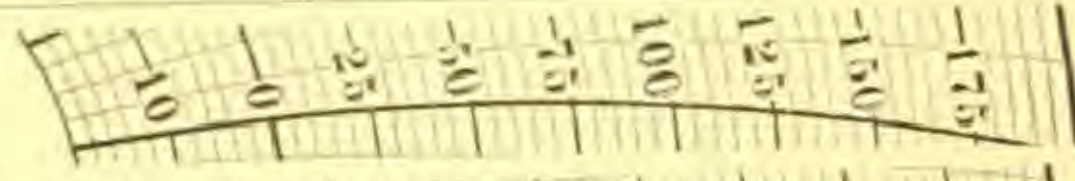
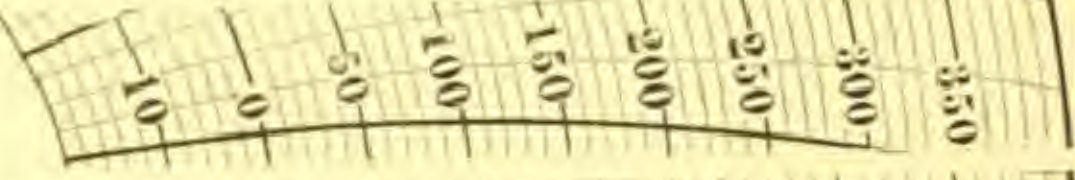

**Combination Pressure and Vacuum**  
**INCHES HEAD OF WATER VACUUM AND INCHES**  
**HEAD OF WATER PRESSURE**

Used with Models 11, 12, 40 and 45

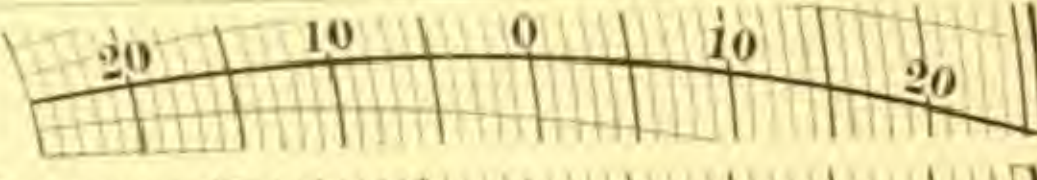
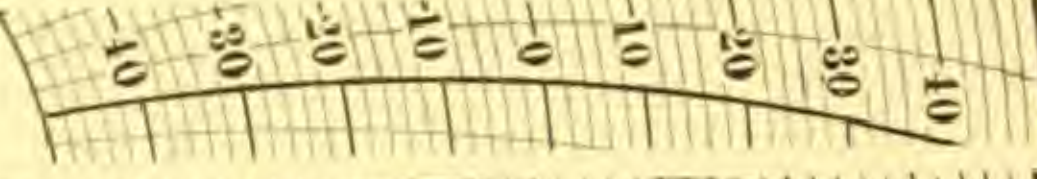
(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Inches Head of Water Vacuum and Inches Head of Water Pressure
*2346	25" V. to 25" P.	24 Hrs.	
*2220	15" V. to 40" P.	24 Hrs.	
*4655	5" V. to 60" P.	24 Hrs.	

**FEET HEAD OF WATER VACUUM AND FEET HEAD**  
**OF WATER PRESSURE**

**2365	24' V. to 200' P.	24 Hrs.	
**2366	20' V. to 400' P.	24 Hrs.	
**2367	24' V. to 700' P.	24 Hrs.	

**MILLIMETERS HEAD OF WATER VACUUM AND**  
**MILLIMETERS PRESSURE**

**2127	25 V. to 25 P.	24 Hrs.	
*2247	50 V. to 50 P.	24 Hrs.	
*2133	100 V. to 100 P.	24 Hrs.	
*2277	150 V. to 150 P.	24 Hrs.	
*2224	300 V. to 300 P.	24 Hrs.	

\* and \*\* Asterisks refer to Lists, see page 76.

TEMPERATURE

ELECTRICITY

MOTION, ETC.




## 8-INCH CHARTS

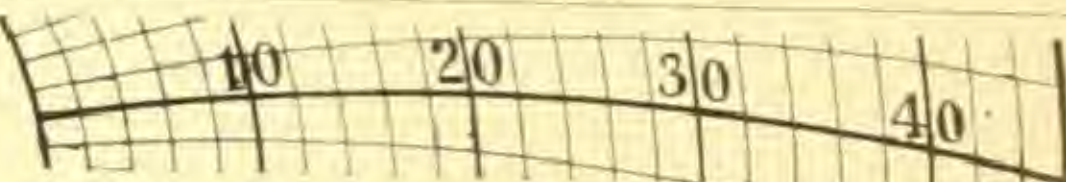
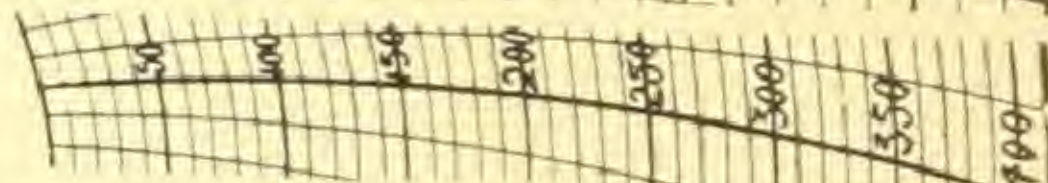
### Combination Pressure and Vacuum CENTIMETERS MERCURY VACUUM AND CENTIMETERS MERCURY PRESSURE

Used with Models 11, 12, 40 and 45

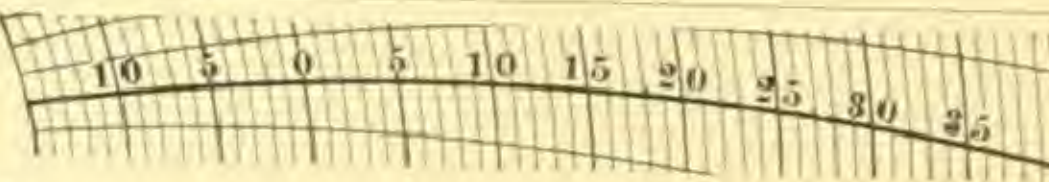
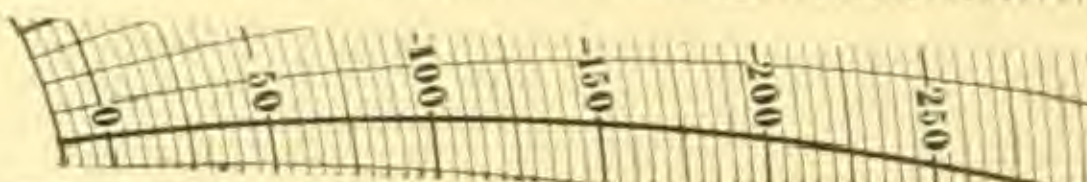
(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts Graduations in Centimeters Mercury Vacuum and Pressure
2012	75 V. to 75 P.	24 Hrs.	

### Pressure for Ammonia POUNDS PER SQUARE INCH PRESSURE

**69	0 to 46 Lbs.	24 Hrs.	
**48	0 to 410 Lbs.	24 Hrs.	

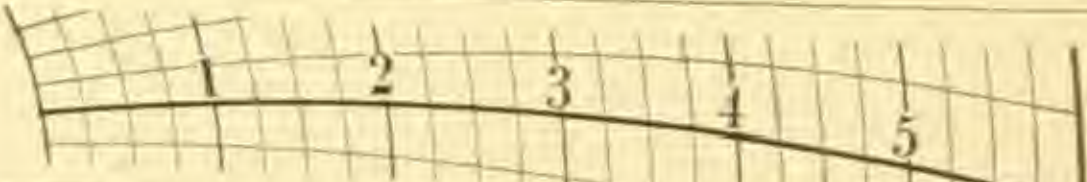
### Combination Vacuum and Pressure for Ammonia POUNDS PER SQUARE INCH VACUUM AND POUNDS PER SQUARE INCH PRESSURE

**2008	15 Lbs. V. to 40 Lbs. P.	24 Hrs.	
**2122	15 Lbs. V. to 300 Lbs. P.	24 Hrs.	

The above ranges for ammonia and similar applications requiring steel pressure elements are only a few of the number available. Many others can be furnished on request.

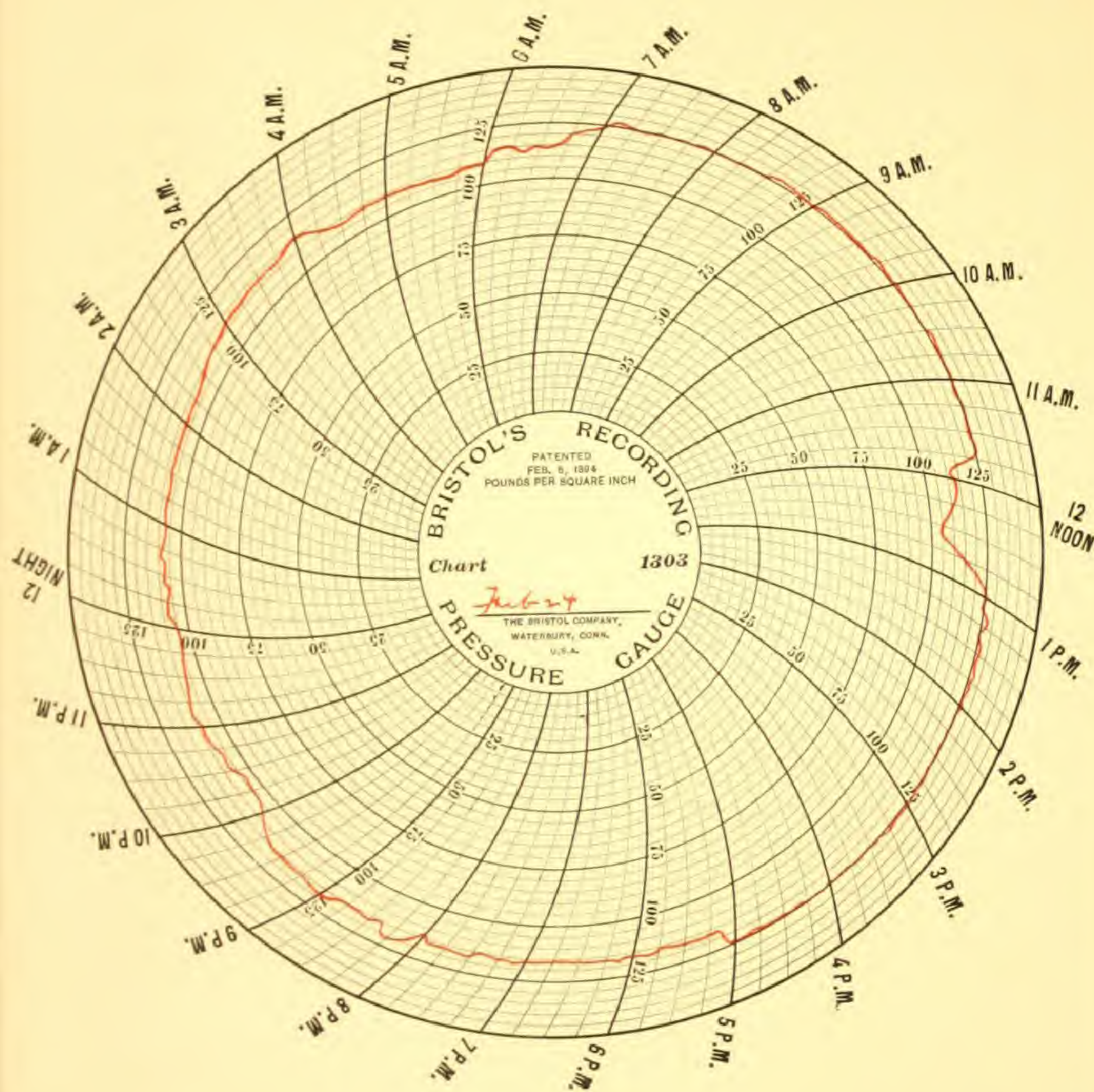
### FEET HEAD OF WATER PRESSURE

For Loss of Head Gauge

**2900	0 to 6 Ft.	24 Hrs.	
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\*\* Asterisks refer to List Prices, see page 76.





Full-size reproductions of 6-inch chart, with specimen record. The instrument is installed in the power plant of an Electric Light Station, and the record shows the boiler steam pressure for 24 hours.

TEMPERATURE

ELECTRICITY

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**6-INCH CHARTS—FOR PRESSURES**

Used only with Model 47

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts
*3204	0 to 5 Pounds per Square Inch Pressure	24 Hours	
3203	0 to 10 Pounds per Square Inch Pressure	24 Hours	
3244	0 to 25 Pounds per Square Inch Pressure	7 Days	
3229	0 to 25 Pounds per Square Inch Pressure	24 Hours	
3208	0 to 100 Pounds per Square Inch Pressure	7 Days	
3223	0 to 100 Pounds per Square Inch Pressure	24 Hours	
3205	0 to 100 Pounds per Square Inch Pressure	6 Hours	
3216	0 to 150 Pounds per Square Inch Pressure	7 Days	
3210	0 to 150 Pounds per Square Inch Pressure	24 Hours	
3238	0 to 200 Pounds per Square Inch Pressure	7 Days	
3218	0 to 200 Pounds per Square Inch Pressure	24 Hours	
3237	0 to 250 Pounds per Square Inch Pressure	24 Hours	
*3219	0 to 16 Ounces per Square Inch Pressure	7 Days	
**3201	0 to 2 Inches Head of Water Pressure	24 Hours	
*3202	0 to 4 Inches Head of Water Pressure	24 Hours	
*3220	0 to 6 Inches Head of Water Pressure	24 Hours	
*3221	0 to 8 Inches Head of Water Pressure	7 Days	
*3214	0 to 24 Inches Head of Water Pressure	24 Hours	
*3234	0 to 40 Inches Head of Water Pressure	24 Hours	
*3211	0 to 12 Feet Head of Water Pressure	24 Hours	
3228	0 to 1500 Feet Head of Water Pressure	24 Hours	

\* and \*\* Asterisks refer to List Prices, see Page 76.



**6-INCH CHARTS—FOR VACUUM****Used only with Model 47**

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	Rev. of Chart	Specimen Sections of Charts
**3209	0 to 1 Inch Head of Water Vacuum	24 Hours	
*3225	0 to 4 Inches Head of Water Vacuum	24 Hours	
*3224	0 to 6 Inches Head of Water Vacuum	24 Hours	
*3232	0 to 8 Inches Head of Water Vacuum	24 Hours	
*3227	0 to 40 Inches Head of Water Vacuum	24 Hours	
3207	0 to 25 Inches Head of Mercury Vacuum	24 Hours	
3206	0 to 30 Inches Head of Mercury Vacuum	24 Hours	

**6-INCH CHARTS—COMBINATION PRESSURE AND VACUUM****Used only with Model 47**

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Total Range	One Rev. of Chart	Specimen Sections of Charts
**3231	1 Inch Water Vacuum to 1 Inch Water Pressure (Graduated in Hundredths)	24 Hours	
*3200	4 Inches Water Vacuum to 4 Inches Water Pressure	24 Hours	
*3222	3 Inches Head of Mercury Vacuum to 3 Inches Mercury Pressure	24 Hours	
*3213	4 Pounds Vacuum to 4 Pounds Pressure	24 Hours	
3212	15 Pounds Vacuum to 15 Pounds Pressure	24 Hours	
3215	15 Pounds Vacuum to 40 Pounds Pressure	24 Hours	

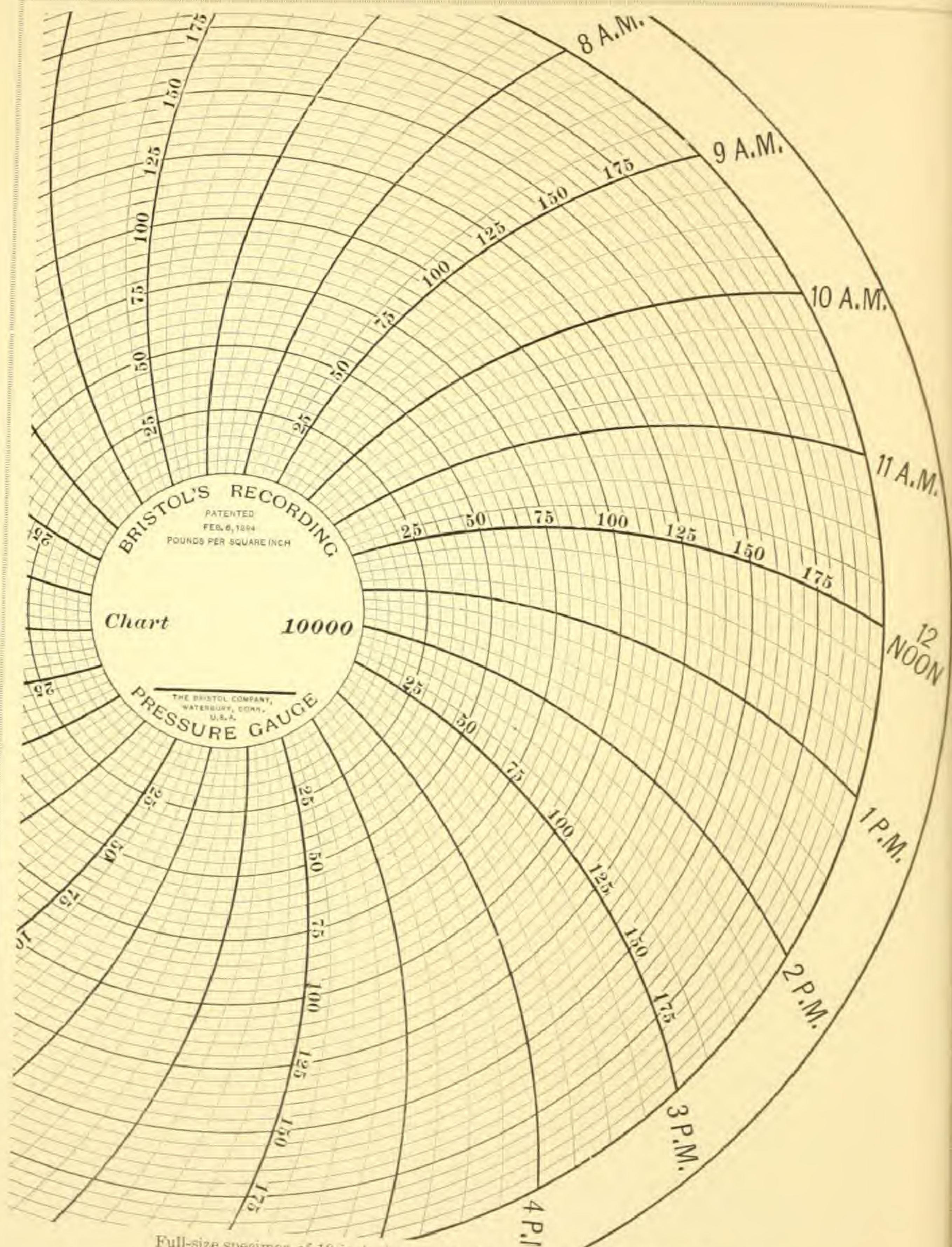
\* and \*\* Asterisks refer to List Prices, see Page 76.

TEMPERATURE

ELECTRICITY

MOTION, ETC.





Full-size specimen of 10-inch chart used with the Round Form Models 41 and 61.

\*10016 0 to 6 In.  
Water P.

\*10017 0 to 12 In.  
Water P.

\*10018 0 to 15 In.  
Sq. In. P.

10004 0 to 25  
Sq. In. P.

10007 0 to 50  
Sq. In. P.

10002 0 to 100  
Sq. In. P.

10005 0 to 150  
Sq. In. P.

10009 0 to 200  
Sq. In. P.

10000 0 to 200  
Sq. In. P.

10001 0 to 250  
Sq. In. P.

10015 0 to 300  
Sq. In. P.

\* Asterisk r



**10-INCH CHARTS—FOR PRESSURES**

Used with Models 61 and 41

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Range	One Rev. of Chart	Specimen Sections of Charts
*10016	0 to 6 In. Head of Water Pressure	24 Hrs.	
*10017	0 to 12 In. Head of Water Pressure	24 Hrs.	
*10010	0 to 15 Lbs. per Sq. In. Pressure	24 Hrs.	
10004	0 to 25 Lbs. per Sq. In. Pressure	24 Hrs.	
10007	0 to 60 Lbs. per Sq. In. Pressure	24 Hrs.	
10002	0 to 100 Lbs. per Sq. In. Pressure	24 Hrs.	
10005	0 to 150 Lbs. per Sq. In. Pressure	24 Hrs.	
10009	0 to 200 Lbs. per Sq. In. Pressure	7 Dys.	
10000	0 to 200 Lbs. per Sq. In. Pressure	24 Hrs.	
10001	0 to 250 Lbs. per Sq. In. Pressure	24 Hrs.	
10015	0 to 300 Lbs. per Sq. In. Pressure	24 Hrs.	

\* Asterisk refers to List Prices, see Page 76.

TEMPERATURE

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# 10-INCH CHARTS—FOR PRESSURES

Used with Models 61 and 41

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Range	One Rev. of Chart	Specimen Sections of Charts
10012	0 to 350 Lbs. per Sq. In. Pressure	24 Hrs.	
10014	0 to 500 Lbs. per Sq. In. Pressure	24 Hrs.	
*10018	0 to 25 Ft. Head of Water Pressure	24 Hrs.	
10011	0 to 250 Ft. Head of Water Pressure	24 Hrs.	

# 10-INCH CHARTS—FOR VACUUM

Used with Models 61 and 41

*10003	0 to 30 Inches Head of Mercury Vacuum	24 Hrs.	
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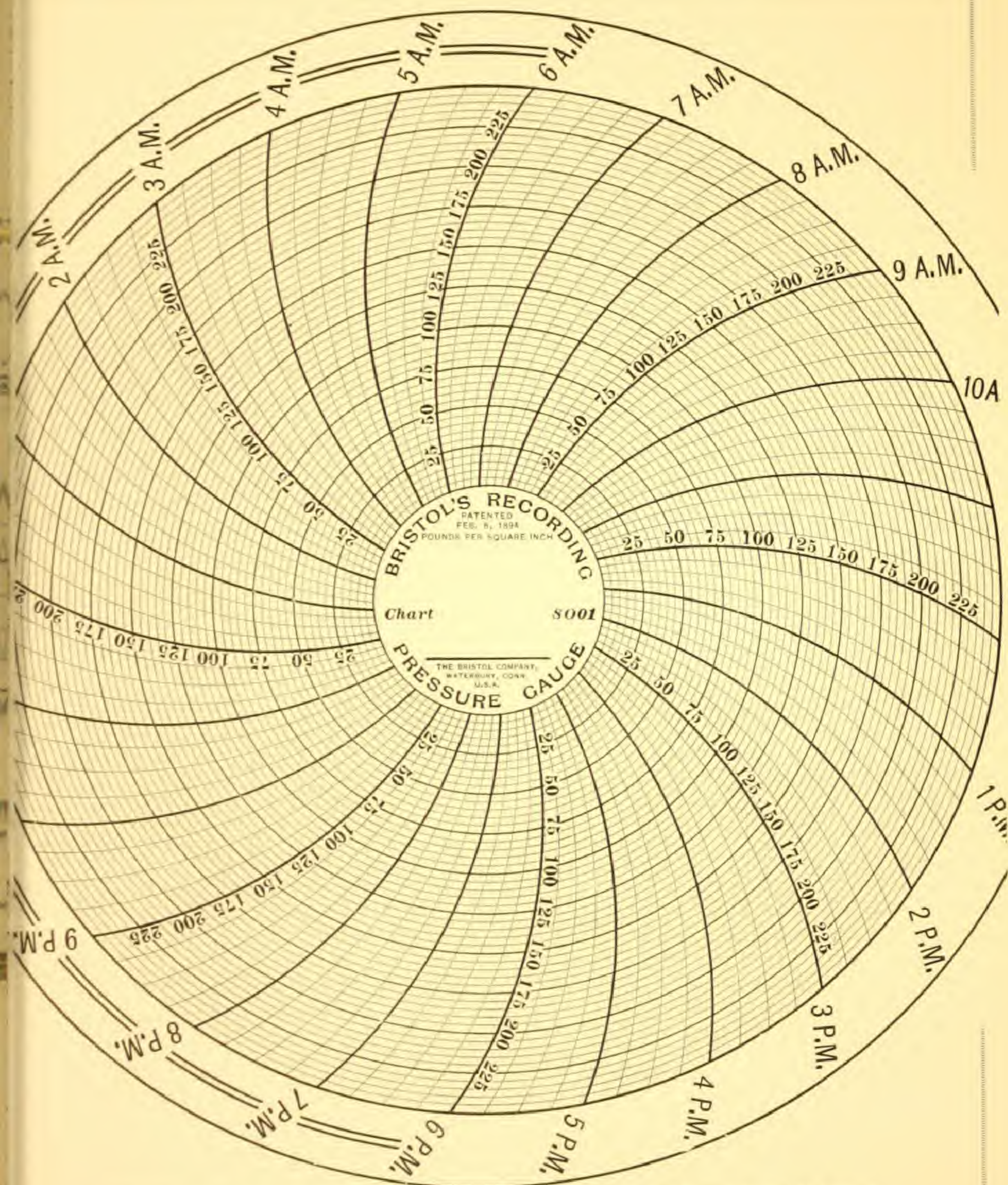
# 10-INCH CHARTS FOR COMBINATION PRESSURE AND VACUUM

Used with Models 61 and 41

10006	30 Ins. Mercury Vacuum to 15 Lbs. Pressure	24 Hrs.	
*10008	2.5 Ins. Water Vacuum to 2.5 Inches Water Pressure	24 Hrs.	

\* Asterisk refers to List Prices, see Page 76.





Full-size specimen section of 8-inch chart, as used with the Round Form Models 61 and 41 Gauges, illustrated on pages 16 and 26.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



# 8-INCH CHARTS—FOR PRESSURES

Used with Models 61 and 41

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Range	One Rev. of Chart	Specimen Sections of Charts
*8012	0 to 6 Lbs. per Sq. In. Pressure	7 Dys.	
*8014	0 to 10 Lbs. per Sq. In. Pressure	24 Hrs.	
8020	0 to 25 Lbs. per Sq. In. Pressure	24 Hrs.	
8018	0 to 50 Lbs. per Sq. In. Pressure	24 Hrs.	
8008	0 to 80 Lbs. per Sq. In. Pressure	24 Hrs.	
8007	0 to 100 Lbs. per Sq. In. Pressure	24 Hrs.	
8000	0 to 150 Lbs. per Sq. In. Pressure	24 Hrs.	
8003	0 to 200 Lbs. per Sq. In. Pressure	24 Hrs.	
8001	0 to 250 Lbs. per Sq. In. Pressure	24 Hrs.	
8013	0 to 300 Lbs. per Sq. In. Pressure	7 Dys.	
8016	0 to 300 Lbs. per Sq. In. Pressure	24 Hrs.	
8004	0 to 360 Lbs. per Sq. In. Pressure	6 Hrs.	
8006	0 to 2000 Lbs. per Sq. In. Pressure	24 Hrs.	

\* Asterisk refers to List Price, see Page 76.



**8-INCH CHARTS—FOR PRESSURES**

Used with Models 61 and 41

(See Pages 76 and 77 for List Prices and Directions for Ordering)

Chart No.	Range	One Rev. of Chart	Specimen Sections of Charts
**8019	0 to 4000 Lbs. per Sq. In. Pressure	24 Hrs.	
8010	0 to 17 Atmospheres Pressure	24 Hrs.	
*8009	0 to 36 Oz. per Sq. In. Pressure	7 Dys.	
*8024	0 to 36 Oz. per Sq. In. Pressure	24 Hrs.	
*8027	0 to 10 Ins. Head of Water Pressure	24 Hrs.	
*8011	0 to 30 Ins. Head of Water Pressure	24 Hrs.	
*8023	0 to 60 Ins. Head of Water Pressure	24 Hrs.	

**8-INCH CHARTS—FOR VACUUM**

Used with Models 61 and 41

*8005	0 to 30 Inches Head of Mercury Vacuum	24 Hrs.	
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**8-INCH CHARTS—FOR COMBINATION PRESSURE AND VACUUM**

Used with Models 61 and 41

8002	30 Ins. Mercury Vacuum to 15 Pounds Pressure	24 Hrs.	
8017	30 Ins. Mercury Vacuum to 60 Pounds Pressure	24 Hrs.	
*8015	6 Ins. Head of Water Vacuum to 6 Ins. Head of Water Pressure	24 Hrs.	

\* and \*\* Asterisks refer to List Prices, see Page 76.

TEMPERATURE

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## LIST PRICES—BRISTOL'S RECORDING PRESSURE AND VACUUM GAUGES

	12-Inch Charts	10-Inch Charts	8-Inch Charts	6-Inch Charts
<b>MODEL No. 11</b> Original Form Case, Black Enamel Finish. Shown on page 12.....	\$61.00 *66.00 **71.00 ***76.00 ****81.00	..... ..... ..... ..... .....	\$50.00 *55.00 **60.00 ***65.00 ****70.00	..... ..... ..... ..... .....
<b>MODEL No. 12</b> Portable Form Case, Wood Finish. Shown on page 18.....	66.00 *71.00 **76.00 ***81.00 ****86.00	..... ..... ..... ..... .....	55.00 *60.00 **65.00 ***70.00 ****75.00	..... ..... ..... ..... .....
<b>MODEL No. 16</b> Portable Form Case, Wood Finish. Shown on page 18.....	..... ..... .....	..... ..... .....	..... ..... .....	39.00 *44.00 **49.00
<b>MODEL No. 40</b> Moisture-Proof Case, Black Enamel Finish. Shown on Page 14.....	66.00 *71.00 **76.00 ***81.00 ****86.00	..... ..... ..... ..... .....	55.00 *60.00 **65.00 ***70.00 ****75.00	..... ..... ..... ..... .....
<b>MODEL No. 41</b> Round Form Case, Black Enamel Finish. Shown on page 23.....	..... ..... .....	44.00 *49.00 **54.00	39.00 *44.00 **49.00	..... ..... .....
<b>MODEL No. 45</b> Water-Proof Case, Black Enamel Finish. Shown on page 15.....	84.00 *89.00 **94.00 ***99.00 ****104.00	..... ..... ..... ..... .....	72.00 *77.00 **82.00 ***87.00 ****92.00	..... ..... ..... ..... .....
<b>MODEL No. 47</b> Eccentric Form Case, Black Enamel Finish. Shown on page 17.....	..... ..... .....	..... ..... .....	..... ..... .....	\$33.00 38.00 43.00
<b>MODEL No. 61</b> Round Form Case, Black Enamel Finish. Shown on page 16.....	..... ..... .....	\$44.00 *49.00 **54.00	39.00 *44.00 **49.00	..... ..... .....

\* If chart as listed has one (\*) asterisk before it, use this list price.  
 \*\* If chart as listed has two (\*\*) asterisks before it, use this list price.  
 \*\*\* If chart as listed has three (\*\*\*) asterisks before it, use this list price.  
 \*\*\*\* If chart as listed has four (\*\*\*\*) asterisks before it, use this list price.

All Above Prices are F. O. B. Waterbury, Conn.

SHIP

Model  
No.

11

12

16

40

41

45

47

61

25

DETAIL

1. MODEL

2. FINISH

3. CONNEC

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4. RANGE

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5. SIZE OF

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6. CHART

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7. CLOCK

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8. WORKIN

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In order

finishes it is se



## SHIPPING WEIGHTS—BRISTOL'S RECORDING PRESSURE AND VACUUM GAUGES

Model No.	Size	Package Dimension in Inches	Net Weight	Gross Weight DOMESTIC	Gross Weight EXPORT
11	12-Inch 8 "	23 x 17 x 9 16 x 13 x 8	21 Lbs. 14 "	35 Lbs. 25 "	38 Lbs. 27 "
12	12 " 8 "	29 x 20 x 12 23 x 17 x 9	17 " 12 "	45 " 35 "	48 " 37 "
16	6 "	16 x 13 x 9	10 "	22 "	24 "
40	12 " 8 " 6 "	29 x 20 x 12 23 x 17 x 9 23 x 17 x 9	40 " 29 " 25 "	65 " 50 " 45 "	70 " 55 " 50 "
41	10 " 8 "	29 x 20 x 12 16 x 13 x 8	18 " 13 "	35 " 25 "	38 " 27 "
45	12 " 8 "	29 x 20 x 12 23 x 17 x 9	41 " 31 "	70 " 55 "	74 " 59 "
47	6 "	16 x 13 x 8	9 "	21 "	24 "
61	10 " 8 "	23 x 17 x 9 16 x 13 x 8	11 " 9 "	32 " 22 "	35 " 25 "
25	—	22 x 14 x 12	30 "	55 "	60 "

## DETAILS FOR ORDERING BRISTOL'S RECORDING PRESSURE AND VACUUM GAUGES

1. MODEL NUMBER (Model 11, 12, 16, 25, 40, 41, 45, 47 and 61.)
2. FINISH OF CASE (if other than standard.)
3. CONNECTIONS (front or back connection.)  
Front connection is standard and will be furnished unless otherwise specified.
4. RANGE  
Maximum and minimum pressure or vacuum; also average working pressure or vacuum which will be required to record. Specify the unit of measurement desired, *i. e.*, inches, feet, etc.
5. SIZE OF CHART  
12-inch, 10-inch, 8-inch, 6-inch diameter round chart.
6. CHART NUMBER  
Give chart number, if listed. In case chart required is not listed, give details as per items Nos. 4 and 5. Special charts can be furnished graduated to order. Prices quoted on request.
7. CLOCK OR REVOLUTION OF CHART  
Round Chart.—24-hour or 7-day are standard. Faster speeds can be furnished when required.  
Strip Chart.—Clock speed 1 inch per hour standard. Can be adjusted for 3 inches and 6 inches per hour; also 1 inch, 3 inches and 6 inches per minute.
8. WORKING CONDITIONS  
State the application for which gauge is to be used, and any unusual conditions in connection with the installation. (If gauge is to be applied where it will be subjected to the attack of corrosive vapors or liquids, etc., this should be stated, so that special seals or other devices may be provided for its protection.)

## TELEGRAPHIC ORDERS

In ordering regularly listed Bristol Recording Gauges to be furnished with standard finishes it is satisfactory to specify more briefly as follows:

- (1) MODEL NUMBER                      (2) CHART NUMBER

TEMPERATURE

ELECTRICITY

MOTION, ETC.



TRADE MARK  
BRISTOL'S  
REG. U. S. PAT. OFFICE

## RECORDING LIQUID LEVEL GAUGE

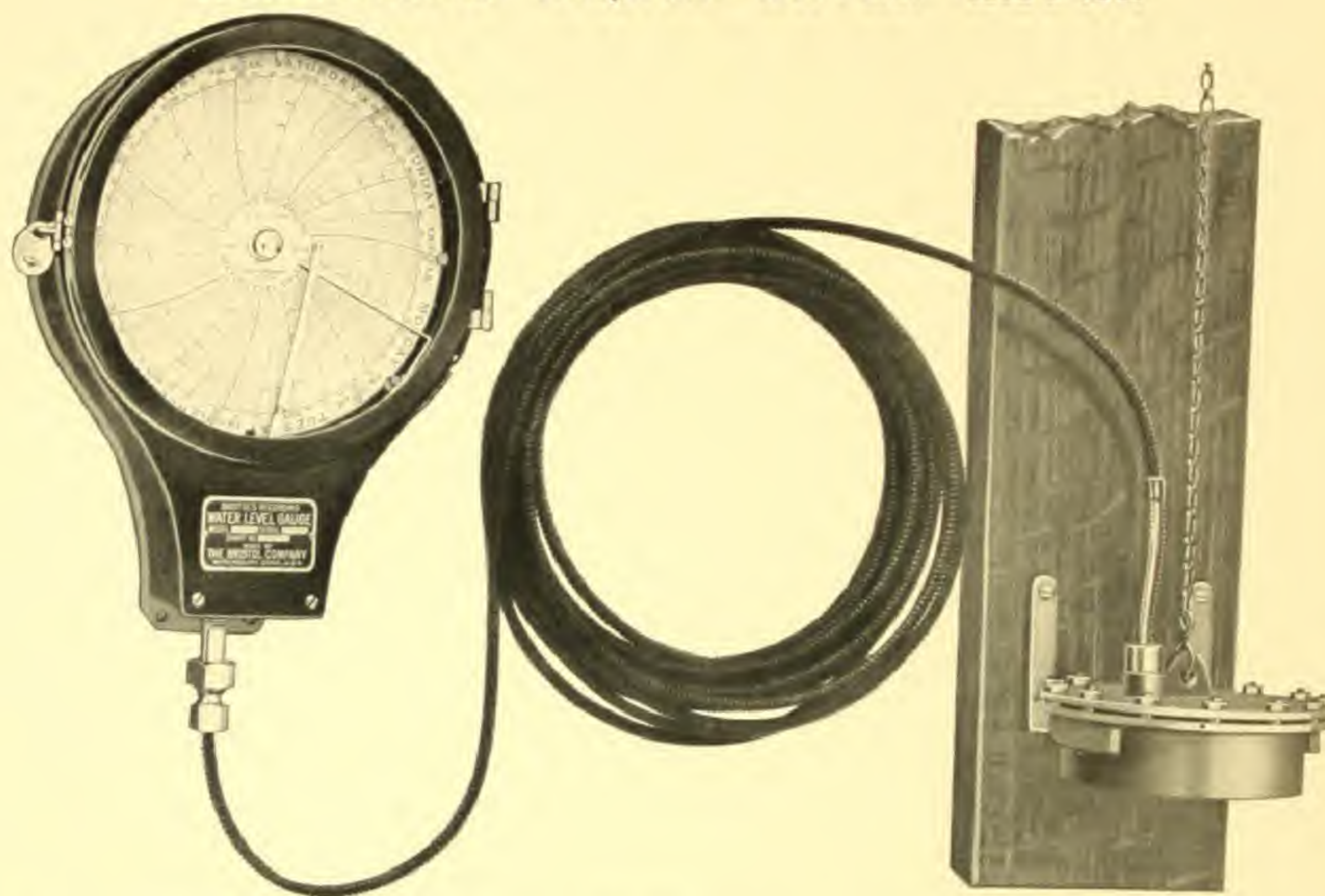


Fig. 1393

To automatically record the depth of water or other liquids in tanks, reservoirs, rivers, canals, sewers, forebays, tail races; also to determine the depth and rate of flow of water over weirs and volumes of liquids in tanks, is the purpose of Bristol's Recording Liquid Level Gauges.

The equipment includes a recording pressure gauge instrument connected by flexible capillary tubing to a sensitive bulb, which is immersed in the liquid, the level of which is to be recorded. The bulb contains a diaphragm against which the pressure of the liquid is exerted. The system is air filled, and the pressures are transmitted through the capillary tubing to the instrument where they are recorded in units of feet, inches or other measurements, as desired.

The recording instrument can be installed at any convenient location either above or below the bulb level. Because air is the transmitting medium there is no danger of freezing and, in fact, the operation of the instrument is not affected by any ordinary temperature.

The complete recording liquid level equipment includes the instrument, capillary

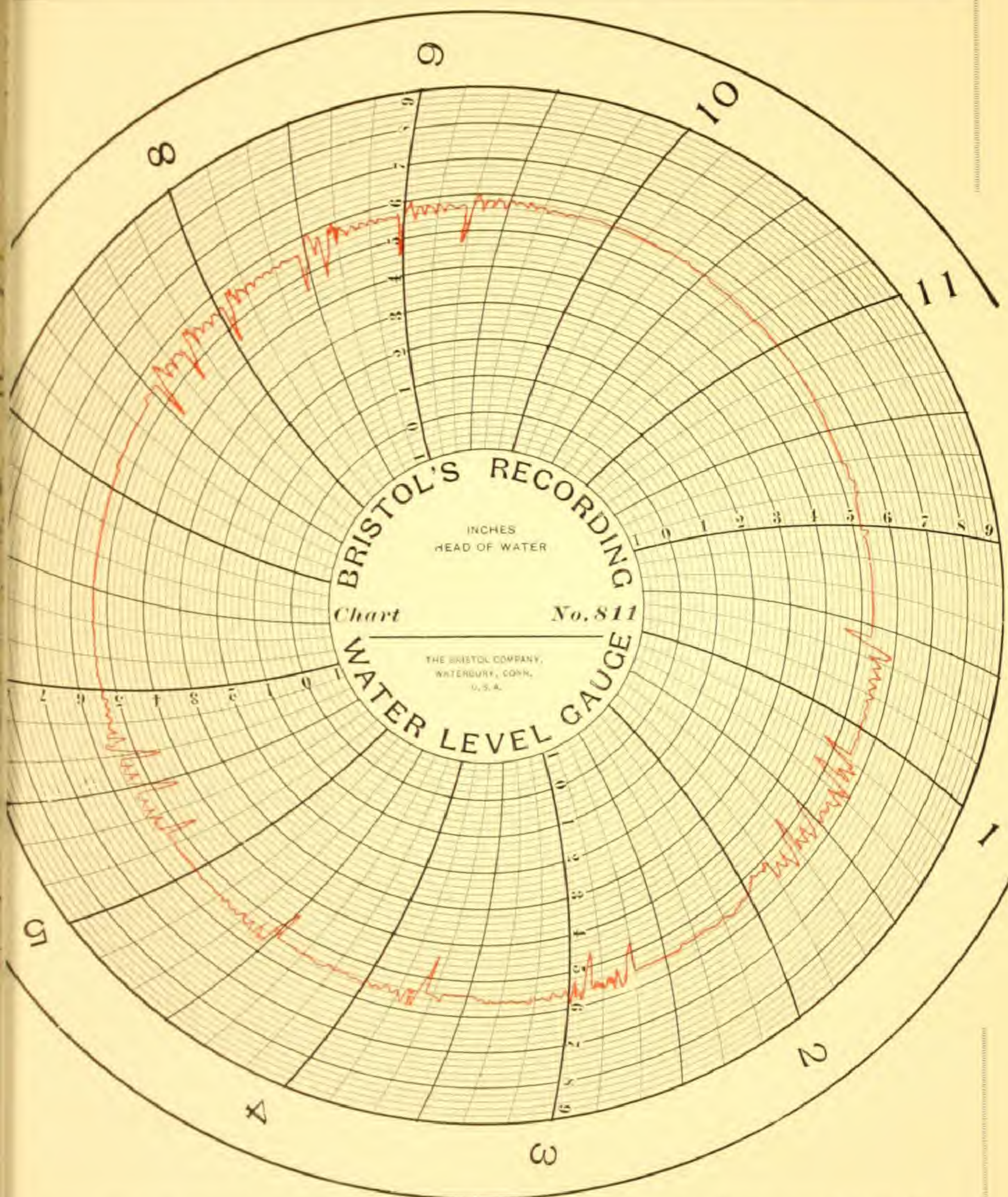
tubing, bulb, bracket for holding bulb, and chain for suspending bulb. All illustrated in Fig. 1920. The standard length of connecting tube is twenty-five feet, but can be furnished in longer lengths as required. The chain is always supplied in lengths three feet longer than the range of the instrument.

Model 11, with standard black enamel finish, is the instrument illustrated here. Charts 12 inches and 8 inches in diameter can be used with this model. See list of charts on page 80.

If instrument is to be installed where it will be exposed to very damp atmospheric conditions, or excessive dust, the Moisture-Proof and Dust-Proof Case Model 40 is recommended. See illustration on page 14. Model 40 employs the same working parts as Model 11 and same charts 12 inches and 8 inches in diameter.

Strip Chart Recording Liquid Level Gauge Model 25, can be furnished for all ranges. This is similar to Pressure Gauge Instrument shown on page 28. Details and prices on request.





TEMPERATURE

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Before Bristol Recording Liquid Level Gauges were installed for this service many disputes arose between the locomotive engineers and track tank tenders. The former claimed that he could not "scoop" enough water for his boiler, because there was not enough water in the tank, and the latter claimed the trouble was with the "scoop" or suction apparatus. The water level gauges placed the responsibility.



# CHARTS USED WITH LIQUID LEVEL GAUGES MODELS 11 AND 40 INCHES HEAD OF WATER

12-INCH CHARTS					8-INCH CHARTS				
Chart No.	Chart Scale in Inches	Total Range in Inches	Each Graduation	One Rev. of Chart	Chart No.	Chart Scale in Inches	Total Range in Inches	Each Graduation	One Rev. of Chart
**894	-2 to +2	0 to 4	1/10-In.	24 Hrs.	**857	0 to 4	0 to 4	1/10-In.	7 Dys.
**895	-1 to +4	0 to 5	1/10-In.	24 Hrs.	**858	0 to 4	0 to 4	1/10-In.	24 Hrs.
**896	0 to 5	0 to 5	1/10-In.	7 Days	**859	0 to 5	0 to 5	1/10-In.	24 Hrs.
*1899	0 to 6	0 to 6	1/10-In.	24 Hrs.	**860	0 to 6	0 to 6	1/10-In.	24 Hrs.
*897	0 to 8	0 to 8	1/5-In.	7 Days	**864	-2 to +4	0 to 6	1/10-In.	24 Hrs.
*898	0 to 8	0 to 8	1/5-In.	24 Hrs.	*866	0 to 8	0 to 8	1/5-In.	7 Dys.
*819	2 to 12	0 to 10	1/10-In.	24 Hrs.	*868	0 to 8	0 to 8	1/5-In.	24 Hrs.
*1802	0 to 12	0 to 12	1/5-In.	7 Days	*872	0 to 12	0 to 12	1/5-In.	24 Hrs.
*1803	0 to 12	0 to 12	1/5-In.	24 Hrs.	*874	-4 to +10	0 to 14	1/4-In.	24 Hrs.
*1801	-4 to +8	0 to 12	1/5-In.	7 Days	*875	0 to 15	0 to 15	1/2-In.	7 Dys.
*4788	0 to 20	0 to 20	1/5-In.	7 Days	*878	-8 to +12	0 to 20	2-In.	24 Hrs.
*5055	0 to 20	0 to 20	1/5-In.	24 Hrs.	*1884	0 to 25	0 to 25	1-In.	24 Hrs.
*1855	-18 to +6	0 to 24	1/2-In.	7 Days	*806	-20 to +5	0 to 25	1-In.	24 Hrs.
*1806	-6 to +24	0 to 30	1/4-In.	24 Hrs.	*1889	0 to 30	0 to 30	1-In.	24 Hrs.
1805	0 to 30	0 to 30	1-In.	7 Days	*882	-15 to +15	0 to 30	1-In.	24 Hrs.
*1808	0 to 40	0 to 40	1/2-In.	7 Days	*884	0 to 35	0 to 35	1-In.	24 Hrs.
*1809	0 to 40	0 to 40	1-In.	24 Hrs.	*883	0 to 36	0 to 36	1-In.	7 Dys.
*1811	0 to 50	0 to 50	1-In.	24 Hrs.	*887	0 to 50	0 to 50	1-In.	24 Hrs.
*1813	0 to 75	0 to 75	1-In.	7 Days	*888	-15 to +40	0 to 55	1-In.	24 Hrs.
*1814	0 to 75	0 to 75	1-In.	24 Hrs.	*889	0 to 60	0 to 60	1-In.	24 Hrs.
*816	-24 to +72	0 to 96	2-In.	7 Days	*890	0 to 75	0 to 75	2-In.	24 Hrs.
*1816	0 to 128	0 to 128	2-In.	24 Hrs.	*891	0 to 110	0 to 110	2-In.	24 Hrs.
*1896	0 to 144	0 to 144	2-In.	24 Hrs.	*877	0 to 120	0 to 120	2-In.	24 Hrs.
*1817	0 to 150	0 to 150	2-In.	7 Days					

# FEET HEAD OF WATER

12-INCH CHARTS					8-INCH CHARTS				
Chart No.	Chart Scale in Feet	Total Range in Feet	Each Graduation	One Rev. of Chart	Chart No.	Chart Scale in Feet	Total Range in Feet	Each Graduation	One Rev. of Chart
*1876	0 to .5	0 to .5	.005-Ft.	24 Hrs.	*5003	0 to 3	0 to 3	1/10-Ft.	24 Hrs.
*851	0 to 1	0 to 1	.02-Ft.	7 Dys.	*5009	-2 to +2	0 to 4	1/10-Ft.	7 Days
*1838	0 to 2.5	0 to 2.5	.1-Ft.	24 Hrs.	*5013	-2 to +2	0 to 4	1/10-Ft.	24 Hrs.
*1831	0 to 5	0 to 5	1/10-Ft.	7 Days	1847	0 to 5	0 to 5	1/10-Ft.	7 Days
*833	-4 to +1	0 to 5	1/10-Ft.	7 Days	*1869	0 to 5	0 to 5	1/10-Ft.	24 Hrs.
*831	-4 to +1	0 to 5	1/10-Ft.	24 Hrs.	*1852	0 to 6	0 to 6	1/4-Ft.	24 Hrs.
*821	0 to 6	0 to 6	1/6-Ft.	24 Hrs.	*814	0 to 8	0 to 8	1/5-Ft.	24 Hrs.
*1833	0 to 7	0 to 7	1/10-Ft.	7 Days	*846	0 to 10	0 to 10	1/5-Ft.	24 Hrs.
*822	0 to 8	0 to 8	1/10-Ft.	24 Hrs.	5045	15 to 25	0 to 10	1/5-Ft.	24 Hrs.
*848	-2 to +6	0 to 8	1/6-Ft.	24 Hrs.	*1870	0 to 12	0 to 12	1/5-Ft.	24 Hrs.
*817	-3 to +7	0 to 10	1/5-Ft.	7 Days	*842	0 to 15	0 to 15	1/5-Ft.	7 Days
*1897	0 to 10	0 to 10	1/5-Ft.	24 Hrs.	*1882	0 to 15	0 to 15	1/5-Ft.	24 Hrs.
*1830	-6 to +6	0 to 12	1/5-Ft.	7 Days	*1873	0 to 16	0 to 16	1/2-Ft.	24 Hrs.
*838	-6 to +6	0 to 12	1/5-Ft.	24 Hrs.	*5043	0 to 20	0 to 20	1/2-Ft.	7 Days
*836	0 to 12	0 to 12	1/6-Ft.	7 Days	*5025	0 to 20	0 to 20	1/2-Ft.	24 Hrs.
*847	0 to 12	0 to 12	1/6-Ft.	24 Hrs.	1843	0 to 25	0 to 25	1-Ft.	7 Days
*1895	0 to 13	0 to 13	1/5-Ft.	24 Hrs.	804	0 to 25	0 to 25	1-Ft.	24 Hrs.
*1848	0 to 15	0 to 15	1/5-Ft.	24 Hrs.	1844	0 to 30	0 to 30	1-Ft.	7 Days
*1832	-3 to +17	0 to 20	1/5-Ft.	7 Days	5024	0 to 30	0 to 30	1-Ft.	24 Hrs.
*840	0 to 20	0 to 20	1/5-Ft.	24 Hrs.	1819	0 to 35	0 to 35	1-Ft.	24 Hrs.
892	0 to 25	0 to 25	1/2-Ft.	7 Days	1892	0 to 40	0 to 40	1-Ft.	24 Hrs.
893	0 to 30	0 to 30	1/2-Ft.	7 Days	1836	0 to 60	0 to 60	2-Ft.	24 Hrs.
830	0 to 50	0 to 50	1-Ft.	7 Days	1874	0 to 80	0 to 80	2-Ft.	24 Hrs.

\*\*\$25.00 Extra List.  
\* 5.00 Extra List.



## DETAILS FOR ORDERING BRISTOL'S RECORDING LIQUID LEVEL GAUGES

1. MODEL NUMBER (Model 11, 40 or 25.)

2. FINISH OF CASE (if other than standard).

3. CONNECTIONS (front or back connection.)

Front Connection is standard and will be furnished unless otherwise specified.

4. RANGE.

Maximum and minimum depth of liquid; also average working depth which will be required to record. Specify the unit of measurement desired; *i. e.*, inches, feet, etc.

5. SIZE OF CHART

12-inch or 8-inch diameter round chart.

6. CHART NUMBER

Give chart number, if listed. In case chart required is not listed, give details as per items Nos. 4 and 5. Special charts can be furnished graduated to order. Prices quoted on request.

7. CLOCK OR REVOLUTION OF CHART

Round Chart.—24-hour or 7-day are standard. Faster speeds can be furnished when required.

Strip Chart.—Clock speed 1 inch per hour standard. Can be adjusted for 3 inches and 6 inches per hour; also 1 inch, 3 inches and 6 inches per minute.

8. TUBING

Length.—25 feet is standard length, may be furnished in longer lengths if required. Soft Seamless Annealed Copper Tubing is standard. When required for use in connection with liquids which attack copper, tubing can be furnished in Lead or Soft Seamless Annealed Steel.

9. WORKING CONDITIONS

State the application for which gauge is to be used, and any unusual conditions in connection with the installation.

10. ACCESSORIES

Specify additional accessories required, such as Micrometer Penarm, Flexible Tubing, Seals, Alarm Attachments, etc.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



## LIST PRICES

### BRISTOL'S RECORDING LIQUID LEVEL GAUGES

INSTRUMENT SPECIFICATION	12-Inch Chart	8-Inch Chart
<b>MODEL 11 RECORDING LIQUID LEVEL GAUGE</b>		
Complete with bronze Bulb; 25-foot Soft Annealed Seamless Copper Connecting Tube; Metal Bracket for holding the Bulb, and chain for suspending Bulb, furnished in lengths 3 feet longer than the total range for which instrument is calibrated . . . . .	\$72.00	\$61.00
Same as above, except with 25-foot Soft Annealed Seamless Steel Connecting Tube and Iron Bulb . . . . .	72.00	61.00
Same as above, except with 25-foot Lead-Protected Connecting Tube and Lead Bulb . . . . .	77.00	66.00
<b>MODEL 40 RECORDING LIQUID LEVEL GAUGE</b>		
Complete with bronze Bulb; 25-foot Soft Annealed Seamless Copper Connecting Tube; Metal Bracket for holding the Bulb, and chain for suspending Bulb, furnished in lengths 3 feet longer than the total range for which instrument is calibrated . . . . .	77.00	66.00
Same as above, except with 25-foot Soft Annealed Seamless Steel Connecting Tube and Iron Bulb . . . . .	77.00	66.00
Same as above, except with 25-foot Lead-Protected Connecting Tube and Lead Bulb . . . . .	83.00	72.00
Additional lengths Soft Annealed Seamless Copper Connecting Tube, per foot . . . . .	. . . .	.22
Additional lengths Soft Annealed Seamless Steel Connecting Tube, per foot . . . . .	. . . .	.22
Additional lengths of Lead-Protected Connecting Tube, per foot . . . . .	. . . .	.44

Above Prices F. O. B. Waterbury, Conn.

## SHIPPING WEIGHTS

### RECORDING LIQUID LEVEL GAUGES

Model	Size	Package Dimensions in Inches	Net Weight	Gross Weight DOMESTIC	Gross Weight EXPORT
11	12-Inch	29 x 20 x 12	29 Lbs.	50 Lbs.	55 Lbs.
	8 "	23 x 17 x 9	22 "	40 "	45 "
40	12 "	29 x 20 x 12	48 "	70 "	75 "
	8 "	23 x 18 x 10	37 "	52 "	57 "



## ADDITIONAL SUPPLIES

### CHARTS

All charts for Bristol's Recording Instruments are numbered, and to avoid delay in delivery, the Chart Number should be specified on all orders for charts.

The name and address of The Bristol Company is printed near the center of all genuine Bristol's Round Charts and on the side of the Strip Charts. Bristol's Recording Instruments are guaranteed to be accurate only when charts bearing the name of The Bristol Company are used.

Bristol's Round Charts are sold by the hundred. When placing orders specify by the hundred or multiple thereof. If otherwise specified, we reserve the right to change to the nearest multiple of 100. Strip Charts are sold by the roll 90 and 30 feet in length. With each new Round Chart Type Recorder are included 100 Charts. With new Strip Type Recorder is included one 90-ft. chart roll.

### LIST PRICES

<b>BRISTOL'S ROUND CHART, 12-Inch and 10-Inch Diameter,</b>	
Per 100	\$1.65
Printed in copying ink, per 100	1.90
7-Day, printed in two colors, per 100	2.20
Onion-skin paper, per 100	2.75
Smoked surface, per 100	4.40
<b>BRISTOL'S ROUND CHART, 8-Inch and 6-Inch Diameter,</b>	
Per 100	.80
Printed in copying ink, per 100	.95
7-Day, printed in two colors, per 100	1.35
Onion-skin paper, per 100	2.75
<b>BRISTOL'S STRIP CHART,</b>	
Per Roll 90 feet long	1.10
Per Roll 30 feet long	.45

### INK

With each Recording Instrument is furnished a bottle of Special Recording Instrument Ink, a combination rubber stopper and glass filler. To obtain satisfactory Records use this Special Ink only.

The standard color of this special ink is red, but other colors can be furnished to order for use in making records on "onion skin" sheets to be blue-printed.

### LIST PRICES

<b>BRISTOL'S SPECIAL RECORDING INSTRUMENT INK,</b>	
One-ounce Bottle	\$ .30
Two-ounce Bottle	.45
Four-ounce Bottle	.65
Half-pint Bottle	1.10
Pint Bottle	1.90
Quart Bottle	3.30
<b>COMBINATION RUBBER STOPPER AND GLASS FILLER</b>	11

### FIXATIVE FOR SMOKED CHARTS

#### LIST PRICES

Fixative Solution for Smoked Charts per quart can	\$ .80
Special Glass Jar for fixing 8-inch Smoked Charts	.30

### CHART HOLDER

#### LIST PRICES

Chart Holder for 8-Inch Round Chart	\$2.20
Chart Holder for 12-Inch Round Chart	2.75
When ordering Chart Holders specify whether for wall or shelf use.	

All Prices on this page are F. O. B. Waterbury, Conn.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



TRADE MARK  
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### THE MOST EXTENSIVE LINE OF RECORDING INSTRUMENTS IN THE WORLD

PRESSURE AND VACUUM  
 Bristol's Recording Pressure and Vacuum Gauges

LIQUID LEVEL  
 Bristol's Recording Water Level Gauges  
 Bristol-Derr Water-Level Gauge for Steam Boilers

TEMPERATURE  
 Bristol's Class I. Recording Thermometers  
 Bristol's Class III. Recording Thermometers  
 Bristol's Class II. Recording Thermometers  
 Wm. H. Bristol Indicating and Recording Electric Pyrometers  
 Bristol's Temperature Controllers

HUMIDITY  
 Recording Wet and Dry Bulb Thermometers

ELECTRICITY  
 Bristol's Recording Voltmeters  
 Bristol's Recording Ammeters  
 Wm. H. Bristol Recording Milli Voltmeters  
 Wm. H. Bristol Recording Shunt Ammeters  
 Bristol's Recording Frequency Meter  
 Bristol's Recording Wattmeters

TIME  
 Bristol's Electric Time Recorders

MOTION  
 Bristol's Mechanical Time Recorders

SPEED  
 Bristol's Recording Tachometers

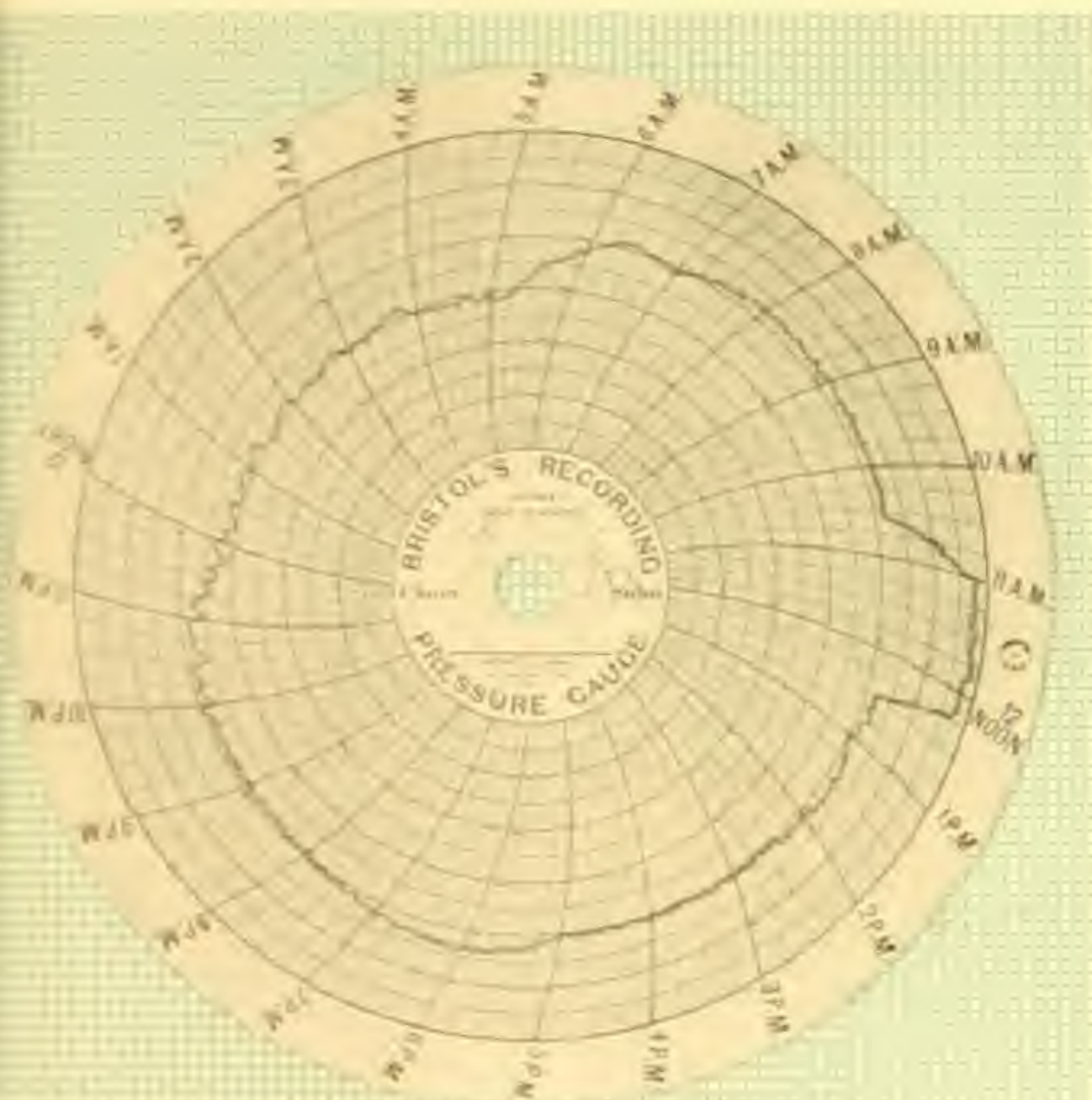
MISCELLANEOUS  
 Supplies for Bristol Recording Instruments  
 Gaugeboard Clocks  
 Bristol Engine Counters  
 Bristol Revolution Counters  
 Bristol-Durand Radii Averaging Instruments  
 Bristol Patent Safety Set Screws

Bristol's Patent Steel Belt Lacing—The Perfect Fastener for All Kinds of Belts



# RECORDED PRESSURES

For Closer Regulation in the  
Distribution System



IN the manufacture and distribution of gas there are many places where a definite knowledge of pressures is valuable. Particularly, in the distribution Department, the problem of supplying a steady flow to suburban developments, together with a growing industrial demand, makes the consideration of adequate pressures of vital importance.

☞ Bristol's Recording Pressure Gauges, as described here, when installed at critical points in the distribution system, furnish a continuous and accurate record of pressure variation, a complete story of what takes place. Such information makes it possible to obtain closer regulation, in fact pressures can be controlled to a point as low as good service will permit.

TEMPERATURE

ELECTRICITY

MOTION, ETC.





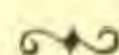
Recording Pressure Gauge Model 11, for permanent mounting. Furnished with 12 inch or 8 inch charts.

## Desirable Locations for Installing Recording Pressure Gauges

1. STATION BOOSTERS
2. AUXILIARY BOOSTERS
3. STATION GOVERNORS
4. AUXILIARY GOVERNORS
5. ON CUSTOMER'S PREMISES

In promoting generally uniform pressure conditions, whether in low pressure city mains, or in the high pressure suburban lines, a careful check should be kept on the action of governors and boosters, both at the station and auxiliary units in outlying sections. This is necessary to forestall any possible loss due to leakage should excess pressures be carried, and to insure favorable conditions at the meters on consumers' premises.

Bristol's recording gauges, installed at these points, furnish continuous chart records of pressures maintained. Such records are valuable, not only to show the degree of unit operating efficiency, but also as reference data in providing satisfactory service.



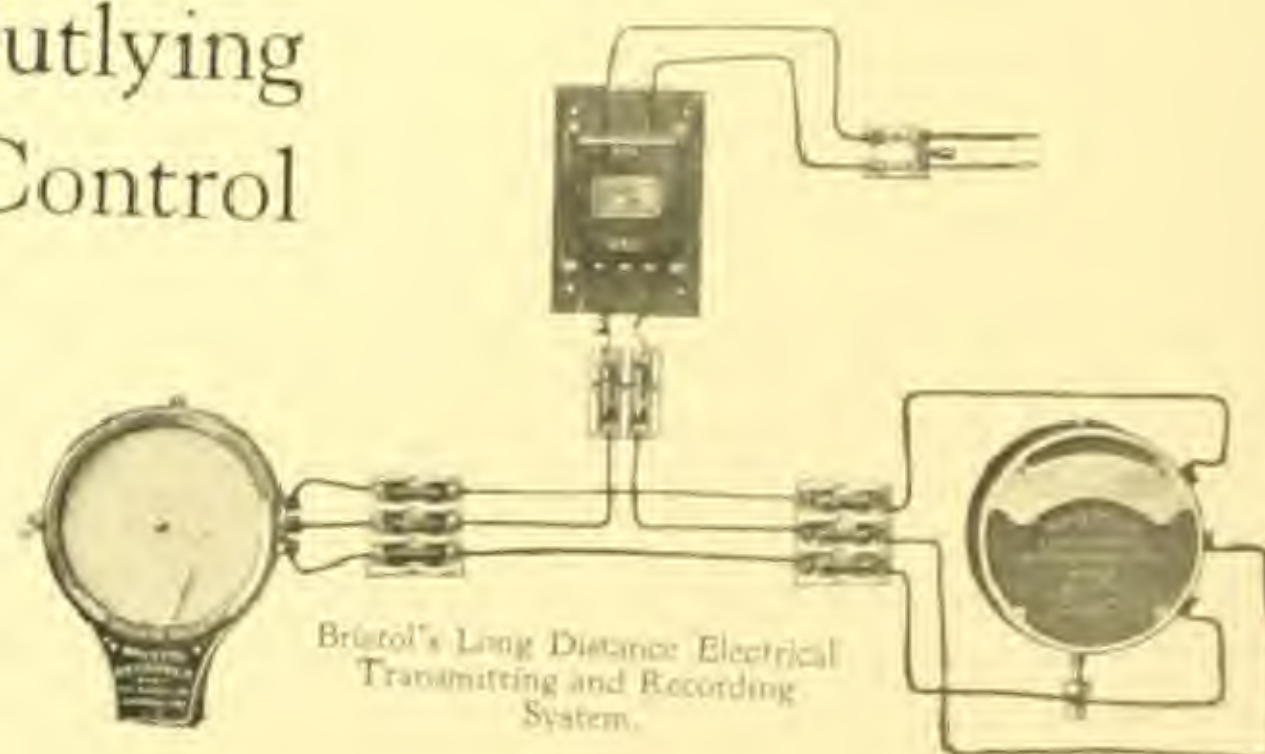
## Long Distance System

### Centralizes Records of Outlying Pressures at the Point of Control

Measurement of pressures maintained at outlying sections of the distribution system may be transmitted by Bristol's Long Distance Electrical Transmitting and Recording System to the recording instrument at the central plant. Here the record is constantly available to the plant engineer, who can watch pressure variations at locations even several miles away.

In this way information is centralized at the point of control, and any tendency of pressures to drop can be noted and corrected before the consumer is affected. It also eliminates the necessity of periodic trips to change the charts.

Many installations of Long Distance Equipment now in operation are proving invaluable, and to



be commercially practical under actual working conditions.

Induction balance is the principle on which the system operates and uses alternating current. There are no complicated or delicate parts to get out of order. The simple, rugged construction insures long, continuous service.



# The Portable Pressure Gauge

22

## For Survey Work

Periodic surveys of pressure conditions are an important part toward efficient distribution. The Portable Bristol's Recording Pressure Gauge shown here provides a most convenient means for obtaining the required information.

Such an instrument can be readily installed at any desired place in the system and furnishes a continuous record of pressures on the chart. This information is valuable in determining the relation of main capacity to demand, and in planning for future expansion.

The instrument is mounted in a strong wooden case, provided with a leather handle for convenience in carrying. The outfit is light in weight, compact in arrangement, including supplies of extra charts and ink, ready for use on the job.



Recording Pressure Gauge, Portable Model 12. Can be furnished with 12 inch or 8 inch charts. Instrument is shown here equipped with "U" tube which provides a continuous check on accuracy — a very desirable feature when used for gas distribution work.

23

## As a Complaint Meter

The trouble department also finds these Portable Recording Pressure Gauges of great assistance in helping to adjust complaints. A Recording Gauge, installed at customer's premises, makes a continuous record of pressures delivered over a period of several days, or weeks as may seem desirable.

Such a record presents proof which the customer can readily understand, and is mutually accepted as true and unbiased.

In assuming such a position the fairness of the company is apparent, and a better business relationship results.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



# Keeping Tabs on District Pressures

The illustration shows typical installation of Recording Pressure Gauge on gas distribution system.

This is one of thirty-nine gauges of this type used by the Minneapolis Gas Light Company, Minneapolis, Minn., located in various parts of the city. Each morning the charts are changed, and by referring to the records it is possible to determine the pressure during the previous 24-hours for any part of the city.

Thus, if there are complaints of low pressure, it is only necessary to look at the chart for the district in question to determine if the complaint is justified.



*Let Bristol's Sales Engineers help you with Recording Instrument problems. They bring to you the benefit of many years' experience, and thus save you the time and trouble of experimenting. After carefully studying your individual needs they specify the correct equipment to do the work.*

*The Bristol Company* *Waterbury, Connecticut*



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TEMPERATURE

ELECTRICITY

MOTION, ETC.







# THE BRISTOL COMPANY

## WATERBURY, CONN., U. S. A.

BRANCH OFFICES

Boston New York Philadelphia Birmingham Pittsburgh Detroit Chicago St. Louis San Francisco

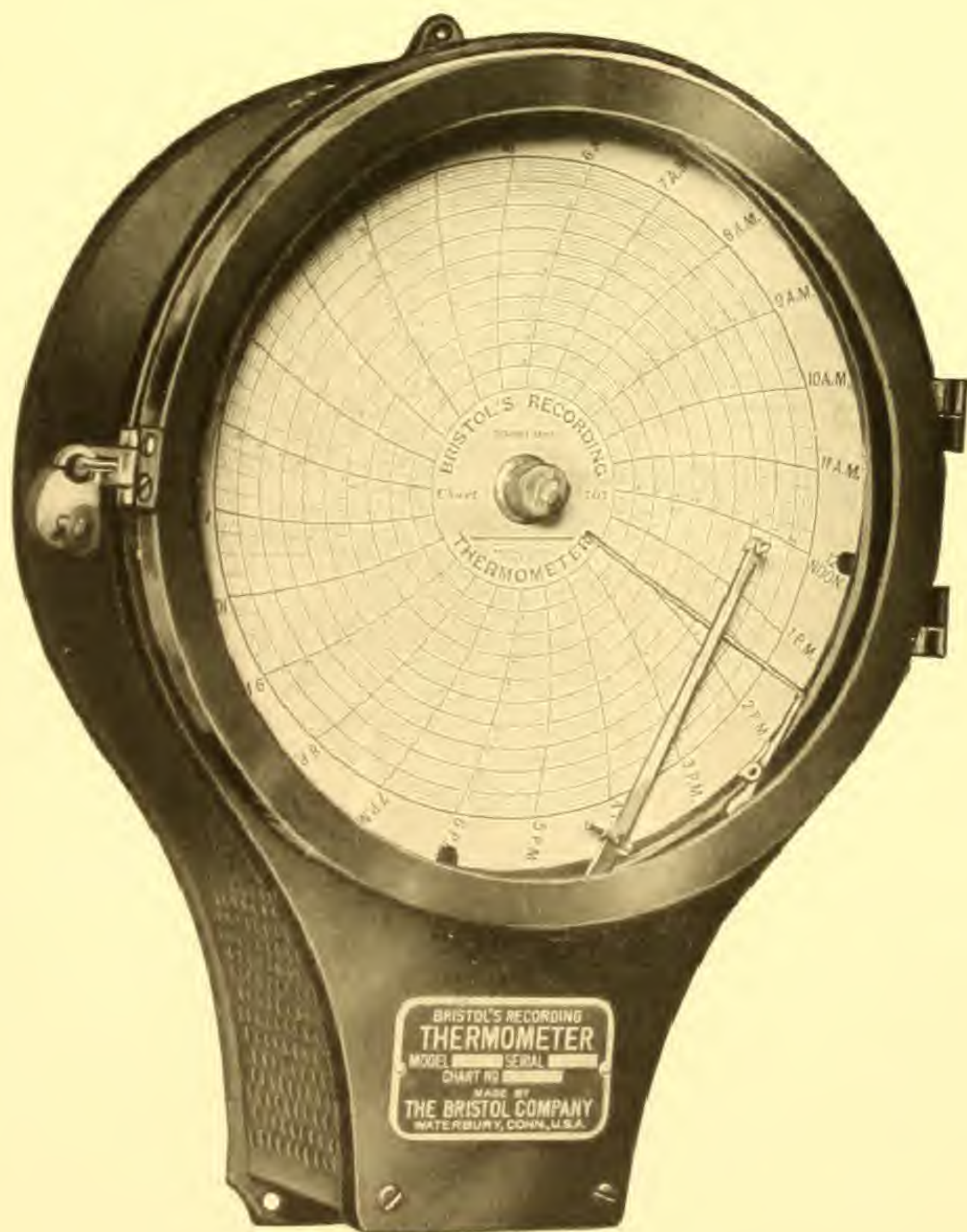
\*CATALOG

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NO. 1104

## BRISTOL'S CLASS I. RECORDING THERMOMETERS

For temperatures between 40° below zero to 150° F. above





## INTRODUCTION

For more than thirty-five years Bristol's Recording Thermometers have been made and sold. During this time the requirements for hundreds of applications have been investigated, and the instrument specified and made to correctly take care of each need. Profiting by this wealth of experience, errors in design and construction have been eliminated, until at the present time there is no question of reliability and efficiency. The big thing is to select and specify from the extensive line of recording thermometers the one most suitable in every way for each particular application.

### Operation

All of the instruments described in this bulletin depend for operation on the expansion of a liquid (which is not mercury). For convenience this type of thermometer is called Class I., to which this bulletin is exclusively devoted. This principle of operation determines the scale range, the degree of sensitivity and physical construction of the instrument, which points are explained below. All of these factors should be taken into consideration when selecting the instrument.

### Range

The extreme limits of ranges covered by the Class I Recording Thermometers are from 40 degrees below zero to 150 degrees Fahrenheit above. Many standard charts have been made to include portions within this range. From these charts those most generally used are listed in this catalog.

### Scale Characteristics

The chart scales for the Class I. Thermometers have uniform graduations over the entire range. This provides a clear and open record at any point on the chart. This is especially important when it is desirable to know the mean or average temperatures; because on charts having uniform gradua-

tions averaging instruments can be used to readily furnish this information.

### Bulbs

The sensitive bulb is the part of the instrument which is actually subjected to the temperatures to be measured. In the Class I. Recording Thermometers this bulb may be located (1) inside the instrument case, (2) attached directly to outside of case, (3) or at the end of a flexible capillary tube. These bulbs may be of different styles for different purposes; plain bulbs for atmospheric temperatures, gases, and immersing in open tanks. Screw bulbs for recording temperatures of steam, liquids, etc., in closed spaces and under pressure. The variety offered makes it possible to use Bristol's Class I. Recording Thermometers for practically every known application.

### Long Distance Recording

When it is desirable to have a Class I. thermometer installed more than a few feet away from the temperature to be measured, Bristol's Long Distance Electrical Transmitting System may be used for any distance, even up to several miles. This type of system is described in a separate bulletin.

### Models

The instruments are available in models for both permanent mounting and portable service. When conditions require, the case can be supplied absolutely moisture-proof and dust-proof, to insure complete protection to the interior working parts.

### Service Rendered

It is the service rendered by these recording thermometers which makes them valuable. They automatically record on the chart the degrees of temperature together with the time and duration at which they take place. The complete temperature history is before you on the chart.

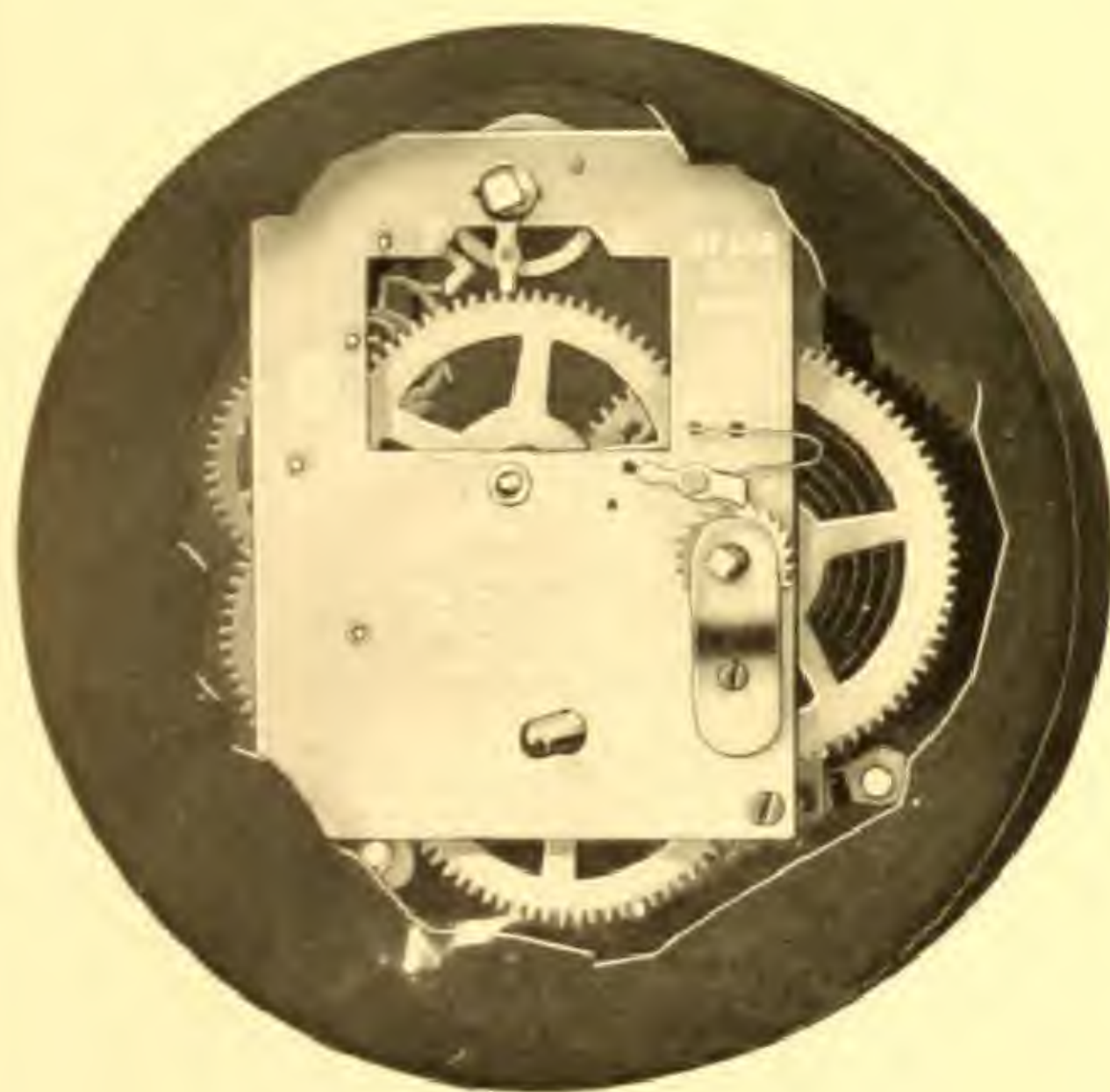


## CLOCK MOVEMENT

### Used in Bristol's Recorders

Located back of the chart in all Bristol's Recording instruments is a clock movement, the purpose of which is to revolve the chart. This is an important function because it makes it possible to furnish the information on the chart as to the exact time at which operations take place.

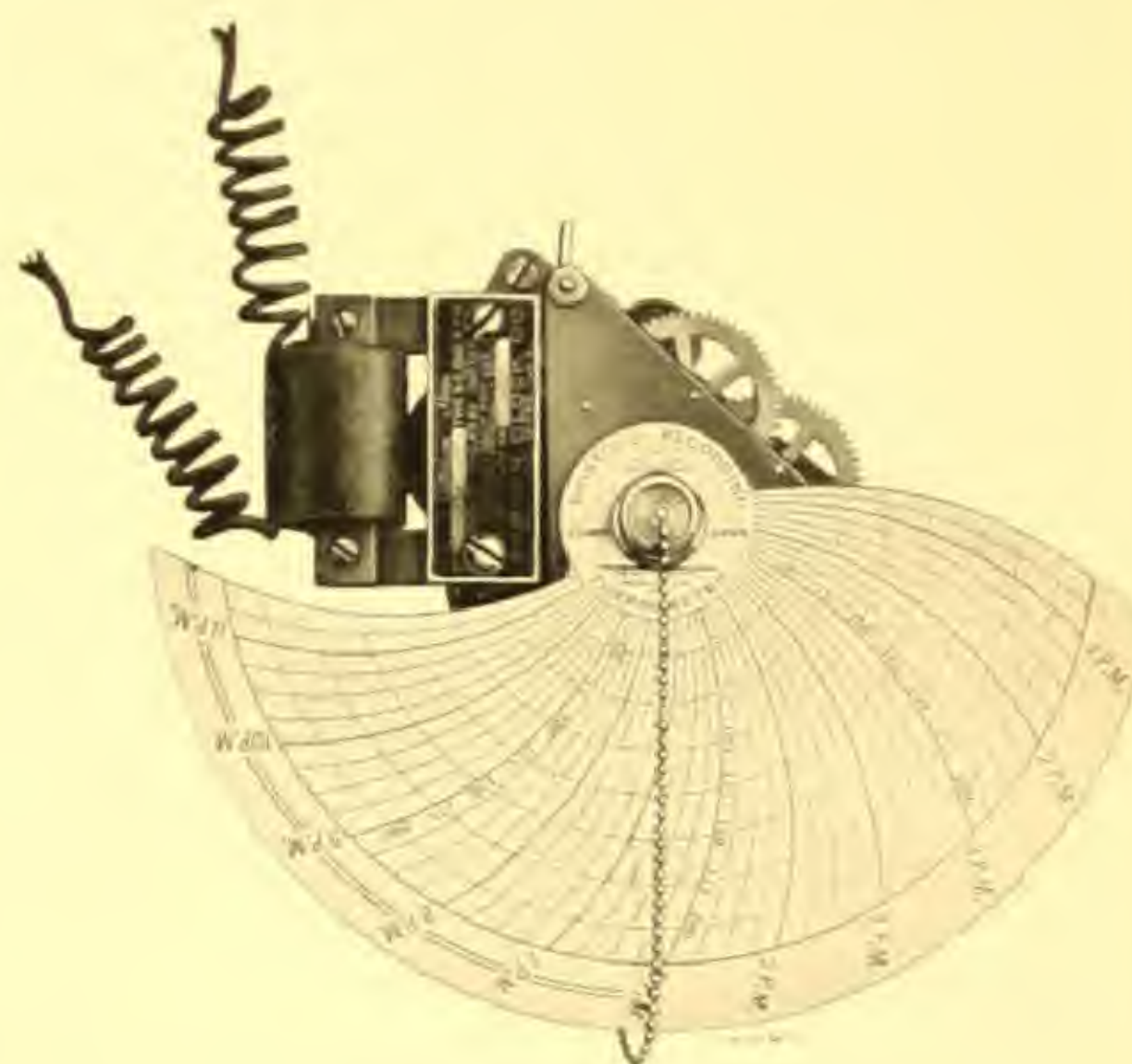
#### Spring Wound Clock



The standard clock used in Bristol's Round Chart Recorders is a Seth Thomas movement, spring wound type. This high-grade movement can be depended upon to operate continuously, and insures a minimum of clock trouble.

Shown in illustration it is mounted in an individual metal case which is furnished as an extra precaution to protect the clock from dust and mechanical injury.

#### Motor Operated Clock



When desired, electrically operated clock can be furnished. It is used in place of a spring wound clock, and, of course has the advantage of no winding required. For large installations where several recorders are used equipped with the electric clocks, it is possible to have all charts operating in unison.

The electric clock furnished with Bristol's Recorders is the Warren Motor Clock. It operates on alternating current where frequency is known to be constant, or where power system has synchronous frequency. It can be furnished to use for 60, 50, 40 or 25 cycles.

This electric clock is available for 24-hour or 7-day revolutions on round chart recorders, and for 1, 3, 6 or 12 inch per hour speeds on strip chart recorders.

As the Electric Clock is not standard equipment an extra charge is necessary. Prices quoted on request.



## SOME OF THE REFINEMENTS FURNISHED WITH BRISTOL'S RECORDING THERMOMETERS

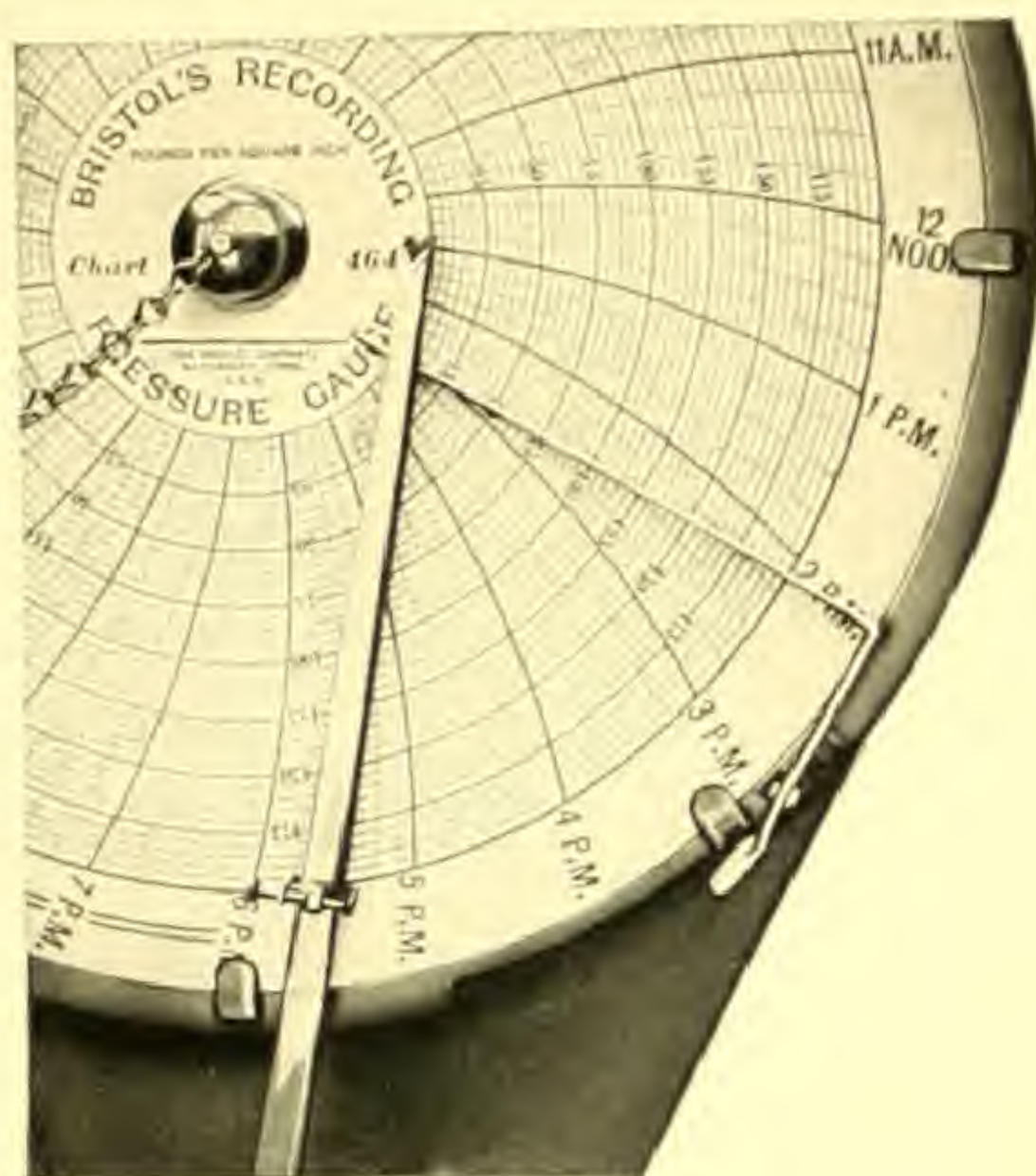


Fig. 1939

### Pen Lifter

This device is furnished as standard equipment with all Bristol's Recorders. With it the chart can be changed conveniently without spoiling the record or injuring the penarm. No extra charge is made for this feature.

### Micrometer Adjustable Pointer

The adjustable pen arm, as shown in Fig. 1939, is also furnished as standard equipment with all Bristol's Recording Thermometers. This simply necessitates turning the small screw to slightly change the adjustment of the Thermometer if this for any reason is necessary. When preferred the pivoted type of adjustable pen arm, shown in Fig. 1870, can be furnished instead. Either type does not influence the price of the instrument.

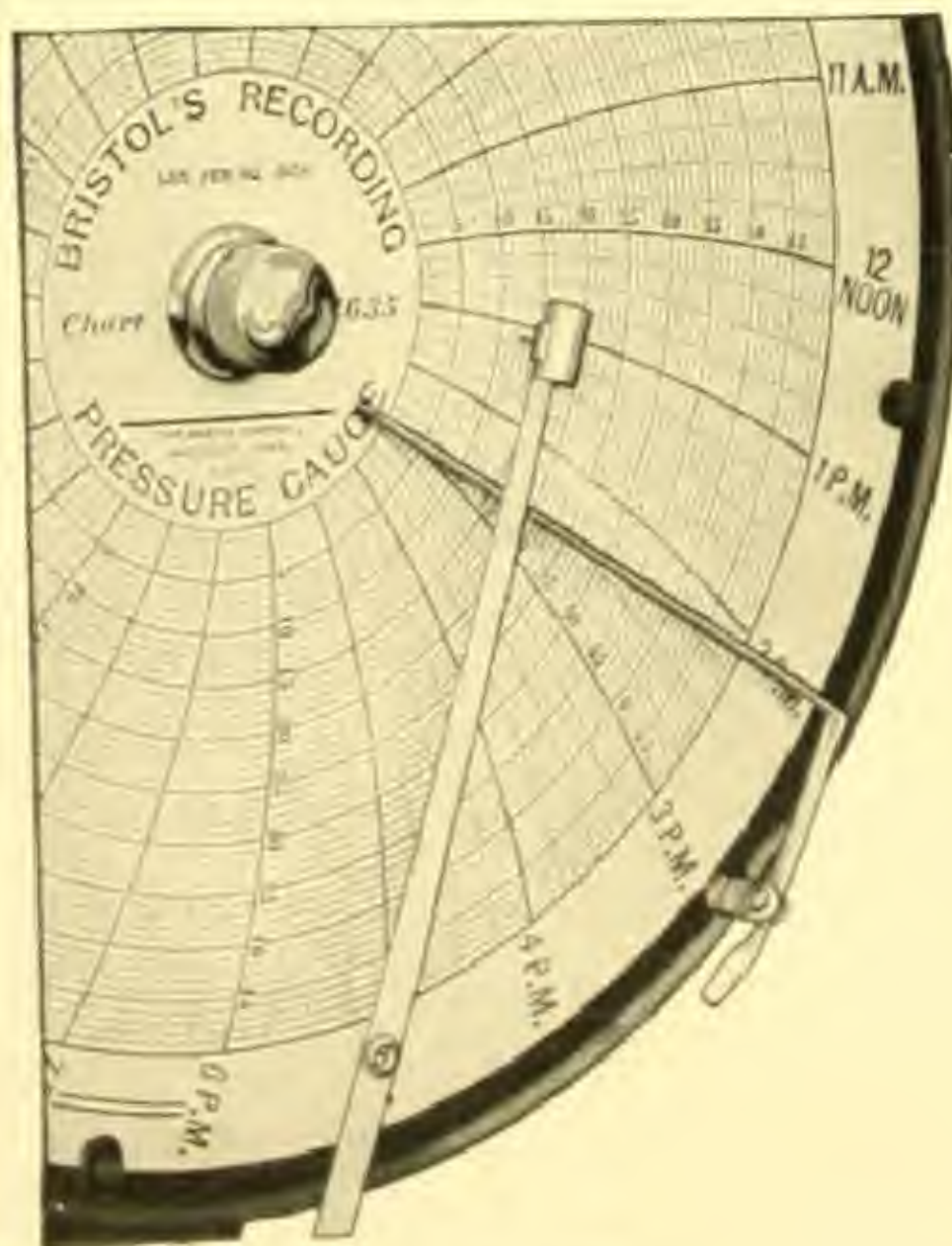


Fig. 1870

### Fountain Pen

Fig. 1870 illustrates the Fountain Pen furnished with Bristol's Recorders when specified. It is exceptionally useful in connection with applications where it is not possible to as frequently place ink in the pen as required by the V-shaped pen shown in Fig. 1939. The Fountain Pen draws a very fine line and can be attached to any Bristol's gauge. Price, 60 cents list.



TRADE MARK  
**BRISTOL'S**  
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**RECORDING THERMOMETER, MODEL 111**  
**WITH SELF-CONTAINED BULB**  
(Used with 12-Inch and 8-Inch Charts)

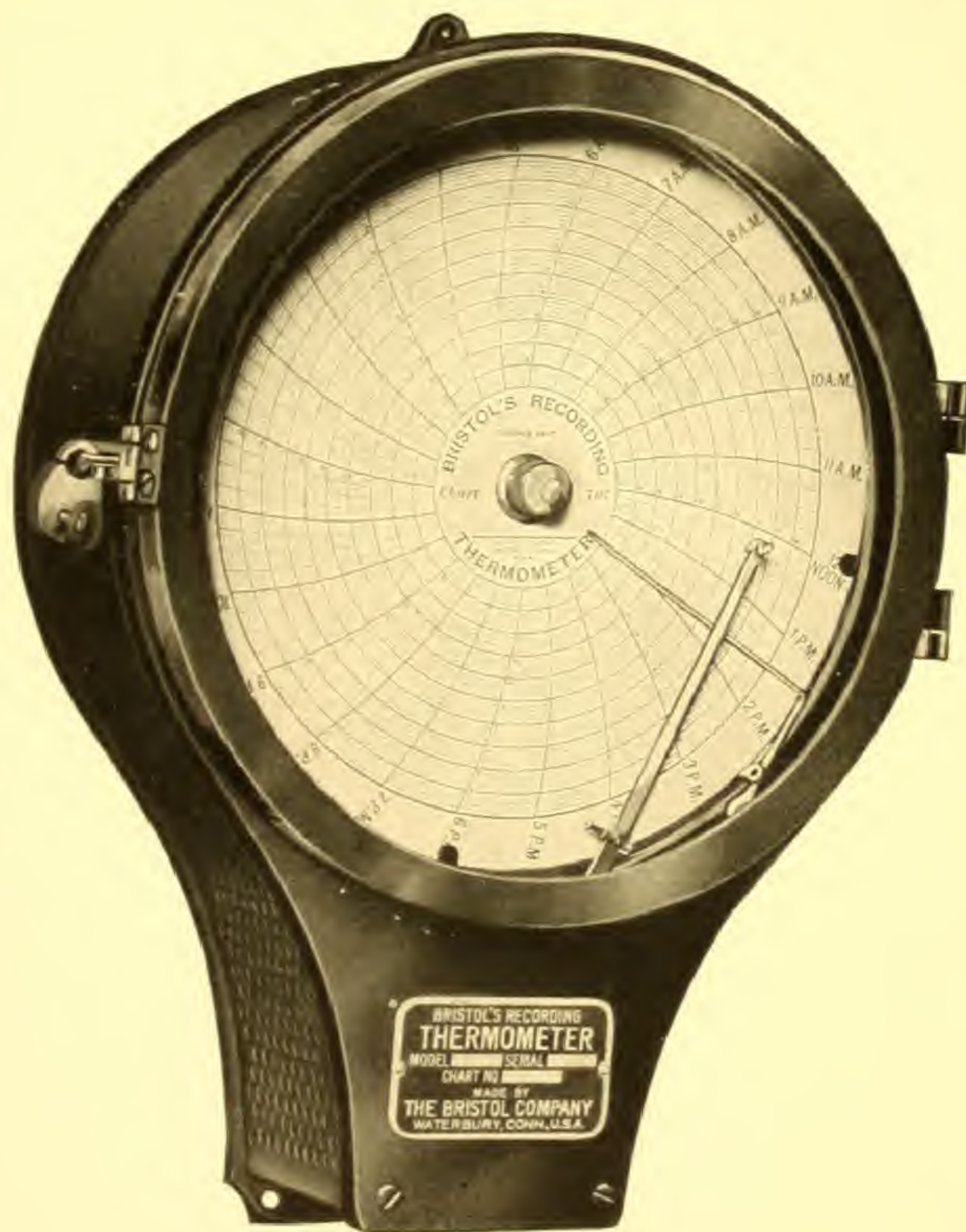


Fig. 1974

The "Sensitive Bulb" in this instrument is enclosed inside the perforated case. This style instrument is well adapted for recording indoor atmospheric temperature, *i. e.*, Public

Buildings, Greenhouses, Drying Rooms, Refrigerating Rooms, etc. Standard finish of case is black enamel.

See Pages 21 and 23 for List of Charts

ELECTRICITY

MOTION, ETC.



TRADE MARK  
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**RECORDING THERMOMETER, MODEL 111**  
**EXTRA SENSITIVE BULB, FIXTURE No. 15**  
 (Used with 12-Inch and 8-Inch Charts)



Fig. 1975

This instrument is intended for applications requiring extreme sensitivity. The "Sensitive Bulb" is a fine spiral of small diameter tubing and responds so quickly to

temperature changes of a minute character that it can be used without hesitation for even the most important work. Standard finish of case is black enamel.

See Pages 21 and 23 for List of Charts



TRADE MARK  
**BRISTOL'S**  
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## RECORDING THERMOMETER, MODEL 111

REAR EXTENSION TYPE BULB, FIXTURE No. 13

(Used with 12-Inch and 8-Inch Charts)

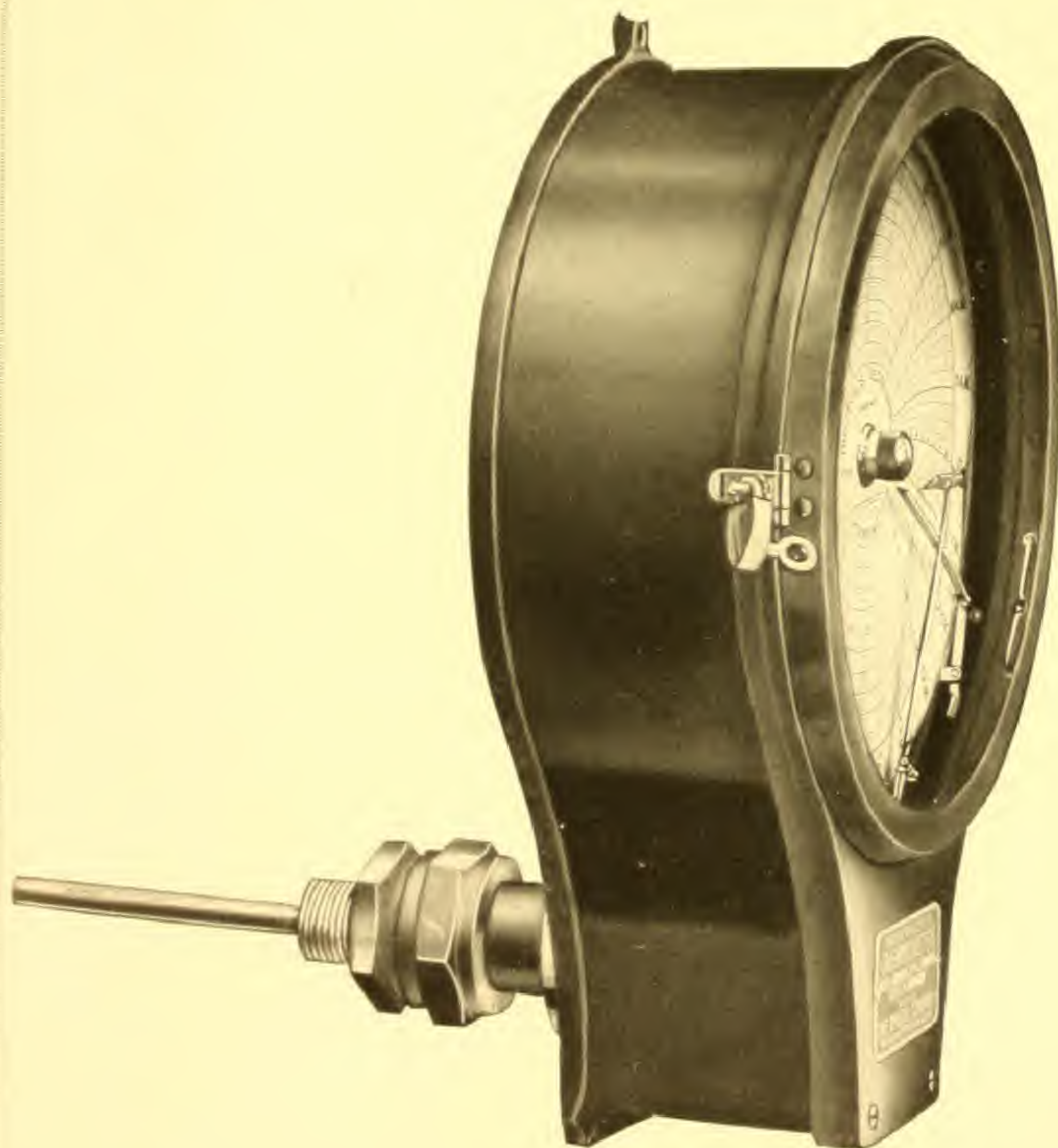


Fig. 1976

The Rear Extension Bulb on this instrument makes it possible to use a Class I. Thermometer in connection with tem-

peratures in closed spaces under pressure; in pipes, tanks, etc. Standard finish of case is black enamel.

See Pages 21 and 23 for List of Charts

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
 REG. U.S. PAT. OFFICE

# **RECORDING THERMOMETER, MODEL 111** **WITH INVERTED PENARM, UNION BULB** **AND CONNECTING TUBE**

(Used with 12-Inch and 8-Inch Charts)



Fig. 2091

Flexible connecting tube between instrument and sensitive bulb permits the bulb to be installed away from the instrument. The bulb with above equipment is No. 182,  $\frac{5}{8}$  inches in diameter and with  $\frac{1}{2}$ -inch union.

Illustration shows instrument with inverted penarm, but similar equipment can also be furnished with vertical penarm with no difference in price. Finish of case is black enamel. Standard length of tubing, 3 feet.

See Pages 21 and 23 for List of Charts



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

**RECORDING THERMOMETER, PORTABLE MODEL 112**  
**EXTRA SENSITIVE BULB, FIXTURE No. 15**

(Used with 12-Inch and 8-Inch Charts)

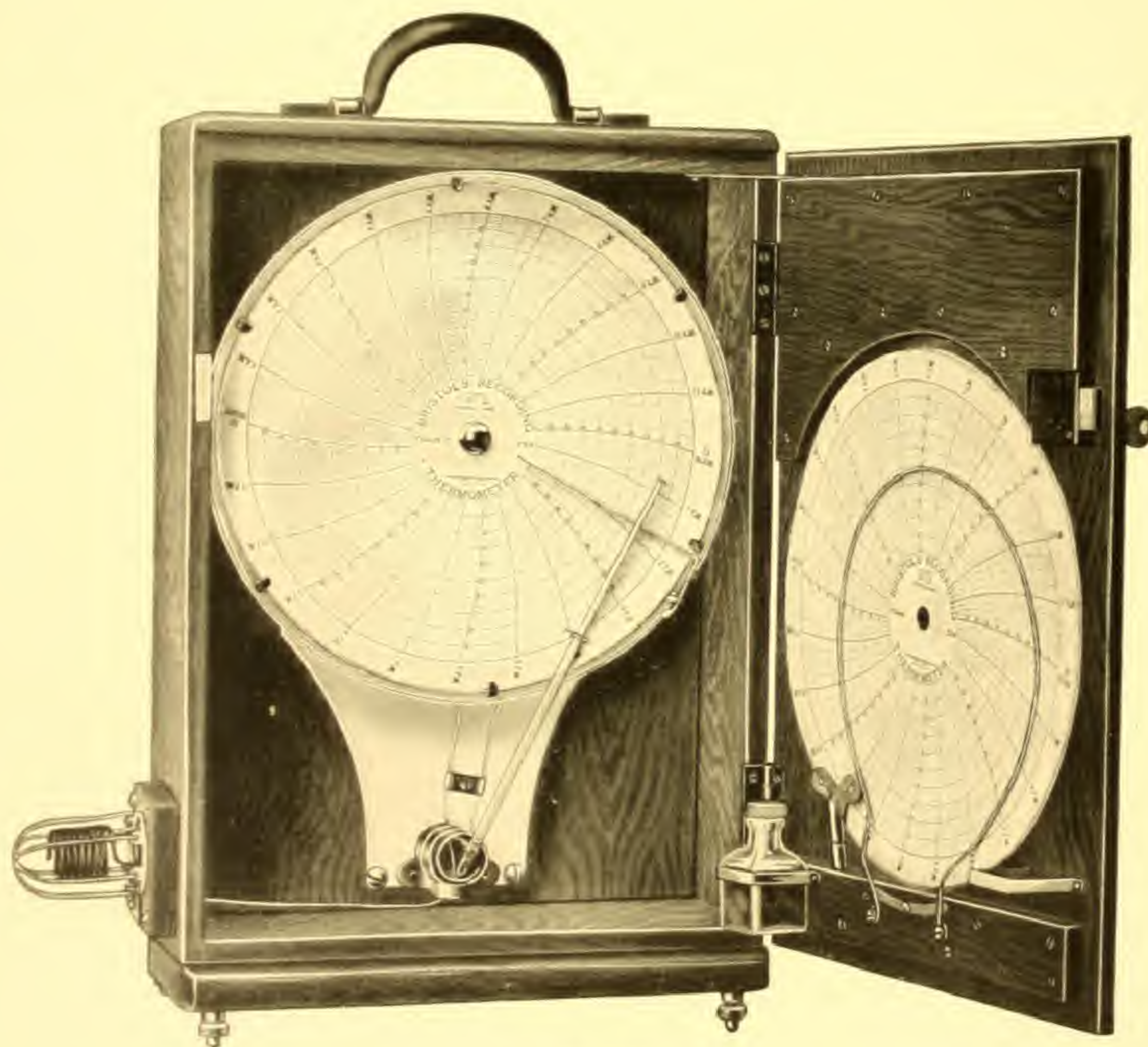


Fig. 2079

Frequently it is important to investigate the temperature conditions in large buildings, apartment houses, etc., and for this service Model 112 is highly recommended. It is

conveniently arranged and very light in weight, as well as extremely sensitive, because of the exposed spiral bulb. The case is light colored varnished wood.

See Pages 21 and 23 for List of Charts

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

**RECORDING THERMOMETER, MOISTURE-PROOF  
MODEL 140. EXTRA SENSITIVE BULB FIXTURE No. 15**

(Used with 12-Inch and 8-Inch Charts)



Fig. 2080

This thermometer is intended for applications requiring a case which will completely protect the interior working parts from

moisture, chemical fumes, etc. Case is cast-iron with black enamel finish.

See Pages 21 and 23 for List of Charts



TRADE MARK  
**BRISTOL'S**  
 REG. U. S. PAT. OFFICE

# **RECORDING THERMOMETER, MOISTURE-PROOF MODEL 140, WITH INVERTED PENARM, PLAIN BULB AND CONNECTING TUBE**

(Used with 12-Inch and 8-Inch Charts)



The Moisture-proof Model 140 Thermometer shown above is made up with inverted penarm and equipped with flexible connecting tube between the instrument and sensitive bulb. This plain bulb No. 102 is  $\frac{3}{8}$  inches in diameter and is suitable for securing temperatures of atmos-

phere in open spaces or liquids in tanks, etc., not under pressure. Standard finish of case is black enamel. Standard length of connecting tube, 3 feet.

Instrument same as above with vertical penarm can be furnished at the same price.

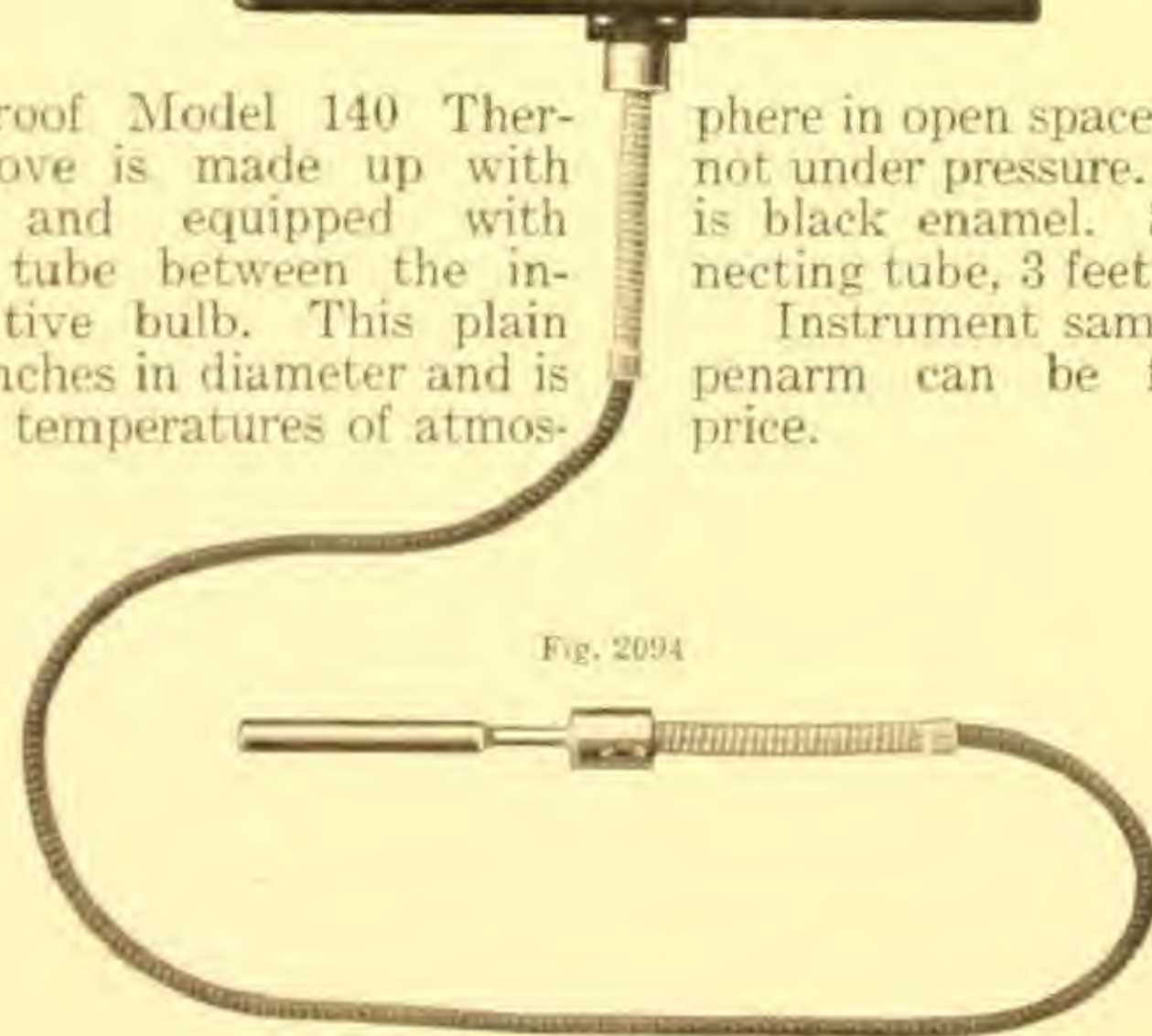


Fig. 2094

See Pages 21 and 23 for List of Charts

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

**RECORDING THERMOMETER,  
ROUND FORM MODEL 168  
WITH SELF CONTAINED BULB**  
(Used with 10-inch and 8-inch Charts)

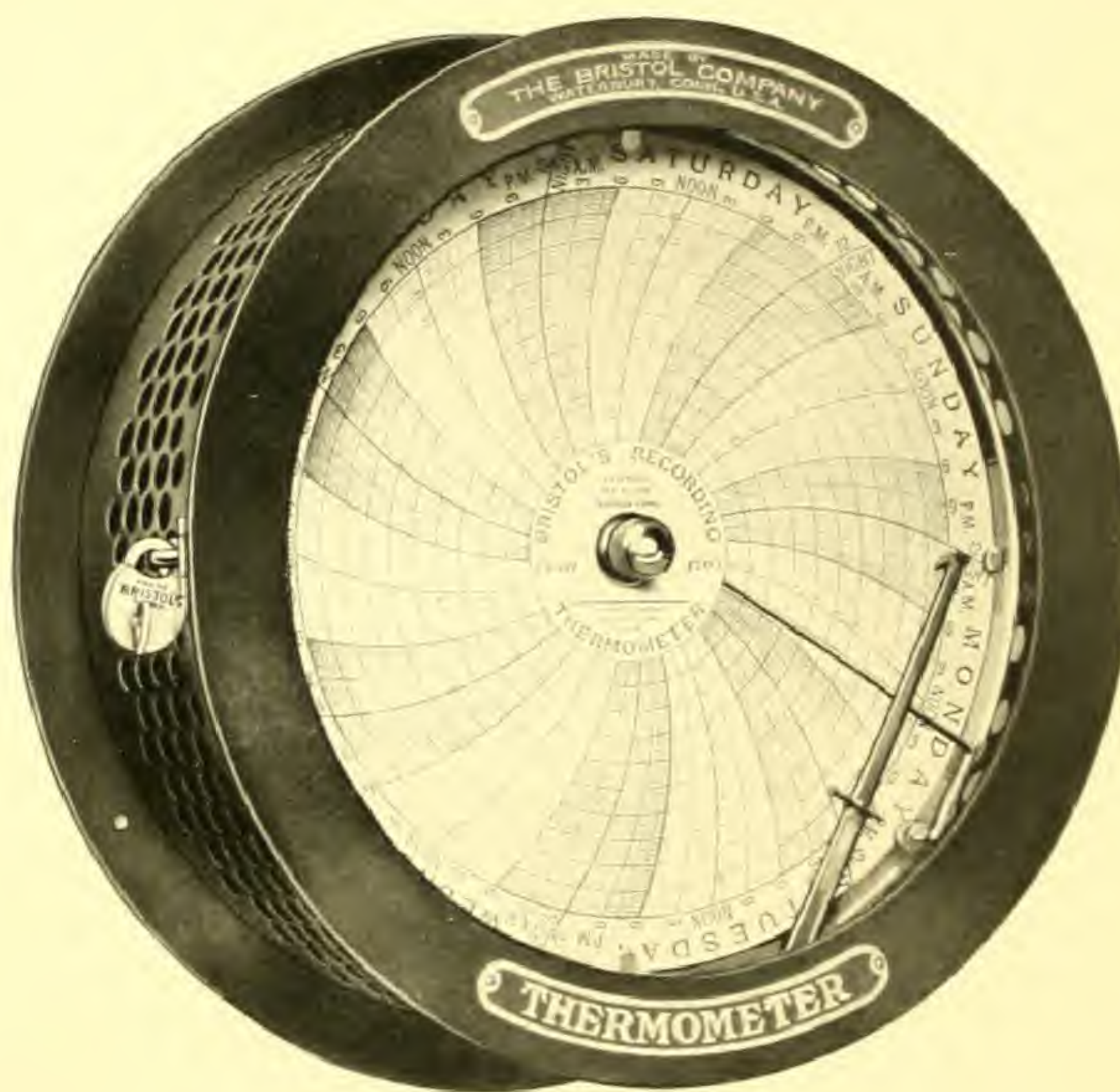


Fig 2066

When it is necessary to economize in space or to comply with specifications in order to match other instruments, this round-form instrument is very often used.

It is smaller in size than Model 111, and lower in price. The working parts, although they are of the same general principle, are necessarily arranged differently, because of the more limited space in the case. However,

it is a desirable and durable instrument where the round-form case is required.

Made in two sizes, for 10-inch and 8-inch charts. List of standard range charts given on page 24. Finish of case is black enamel.

The sensitive bulb is enclosed within the case.

See Page 24 for List of Charts



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

**RECORDING THERMOMETER  
ROUND FORM PORTABLE MODEL 162, WITH UNION  
SOCKET BULB AND CONNECTING TUBE**

(Used with 10-Inch and 8-Inch Charts)

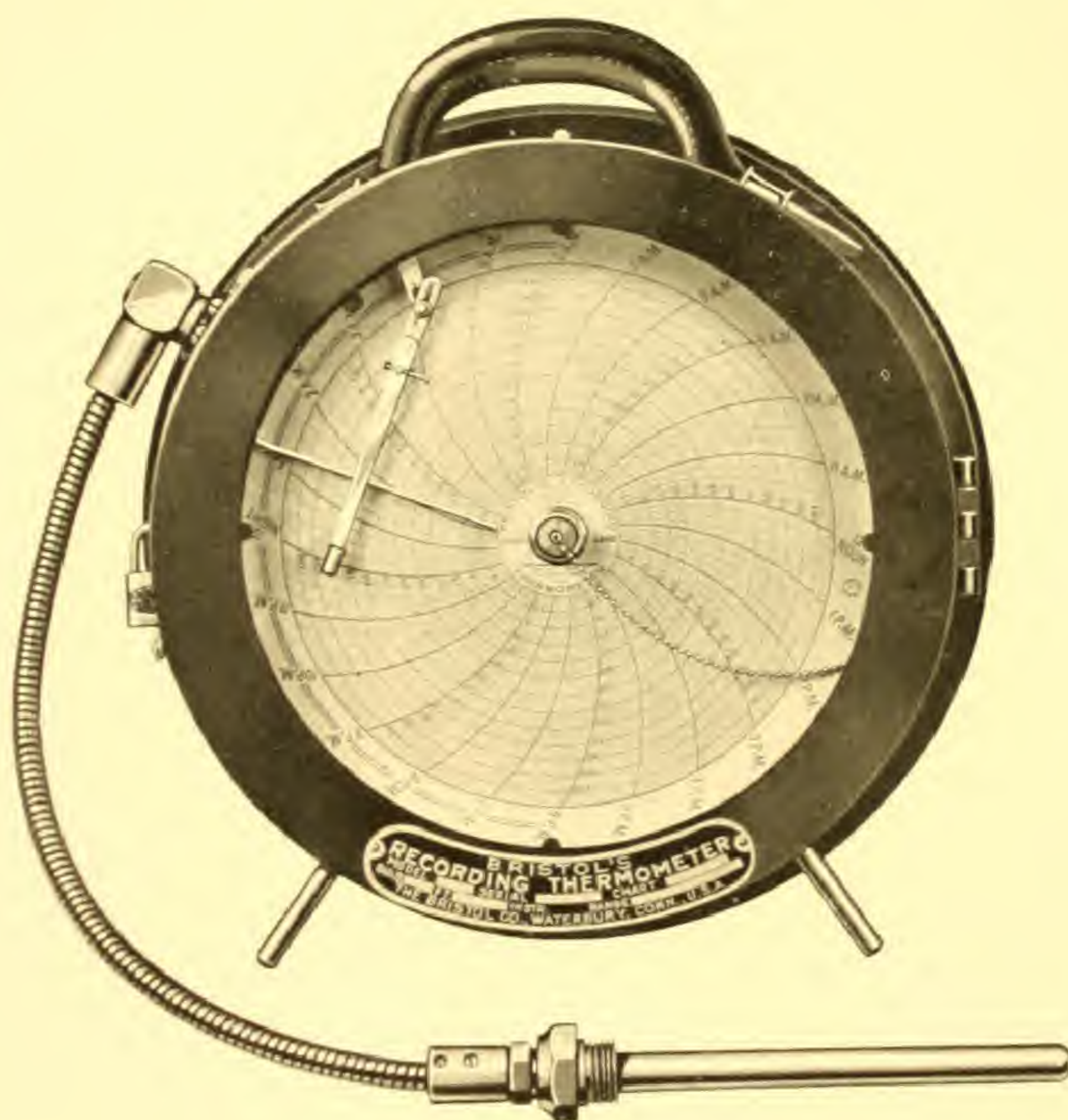


Fig. 2560

This equipment is used when a portable instrument is desired to take readings of temperatures in closed spaces. The Bulb No. 132 has  $\frac{1}{2}$ -inch union connection and separable socket. Flexible connecting tube makes it easy to insert the sensitive bulb in

difficult locations which would be impossible with the self-contained type of instrument, or with bulb attached directly to case. The leather carrying handle makes the instrument easily portable. Finish of case is black enamel. Standard length of connecting tube, 3 feet.

See Page 24 for List of Charts

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

**RECORDING THERMOMETER,  
ROUND FORM PORTABLE MODEL 169  
WITH SELF-CONTAINED BULB**  
(Used with 10-inch and 8-inch Charts)

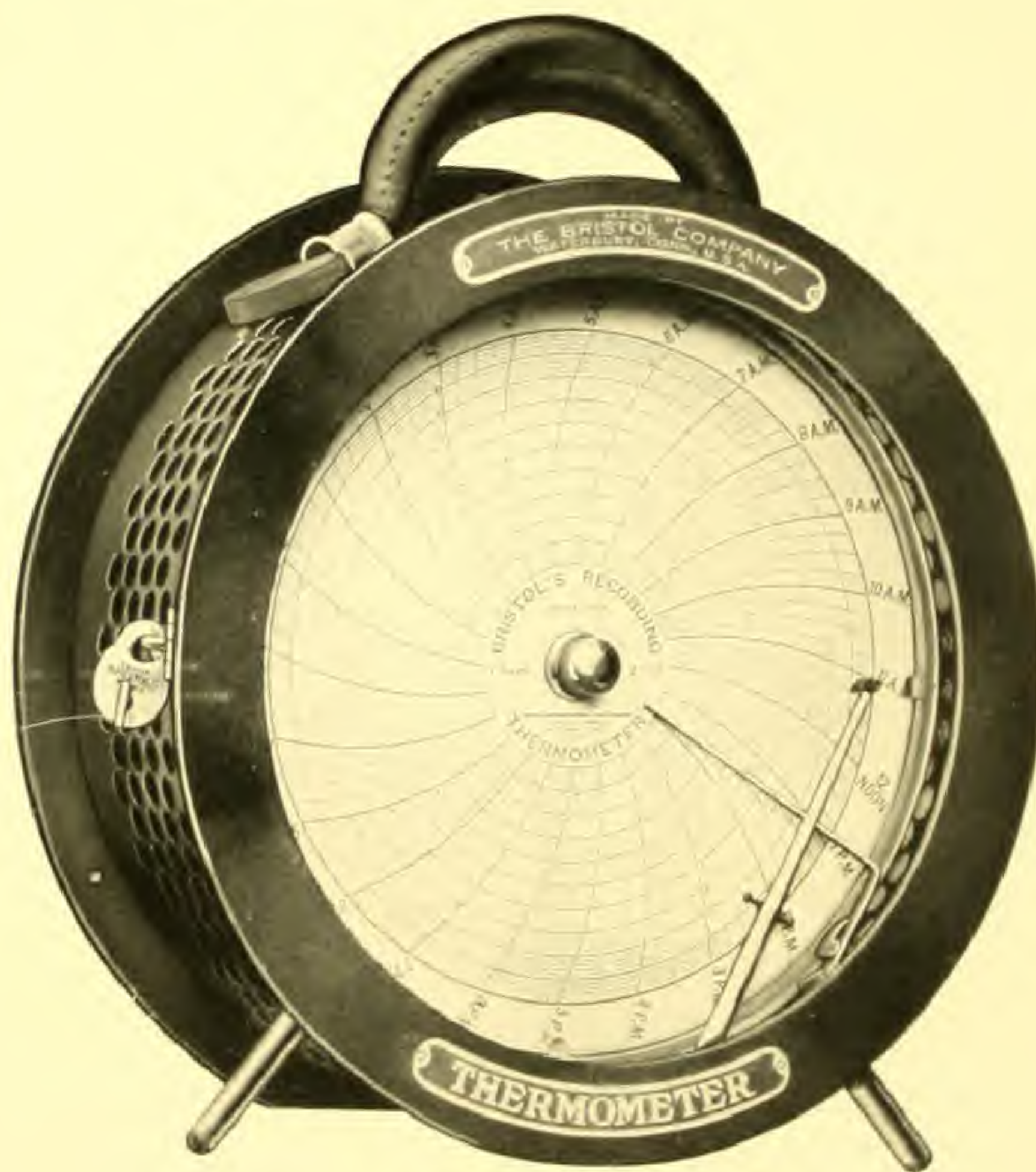


Fig. 2055.

This instrument is the same as Model 168 with the addition of leather handle for carrying and the feet to support in a standing position.

Such a combination makes a very convenient portable instrument for record-

ing atmospheric temperatures at many different locations.

10-inch and 8-inch Charts, listed on page 24, are used with this instrument. Finish of case is black enamel.

The sensitive bulb is enclosed within the case.

See Page 24 for List of Charts



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

## RECORDING THERMOMETER, MODEL 148

### WITH SELF-CONTAINED BULB

(Used with 6-Inch Charts Only)

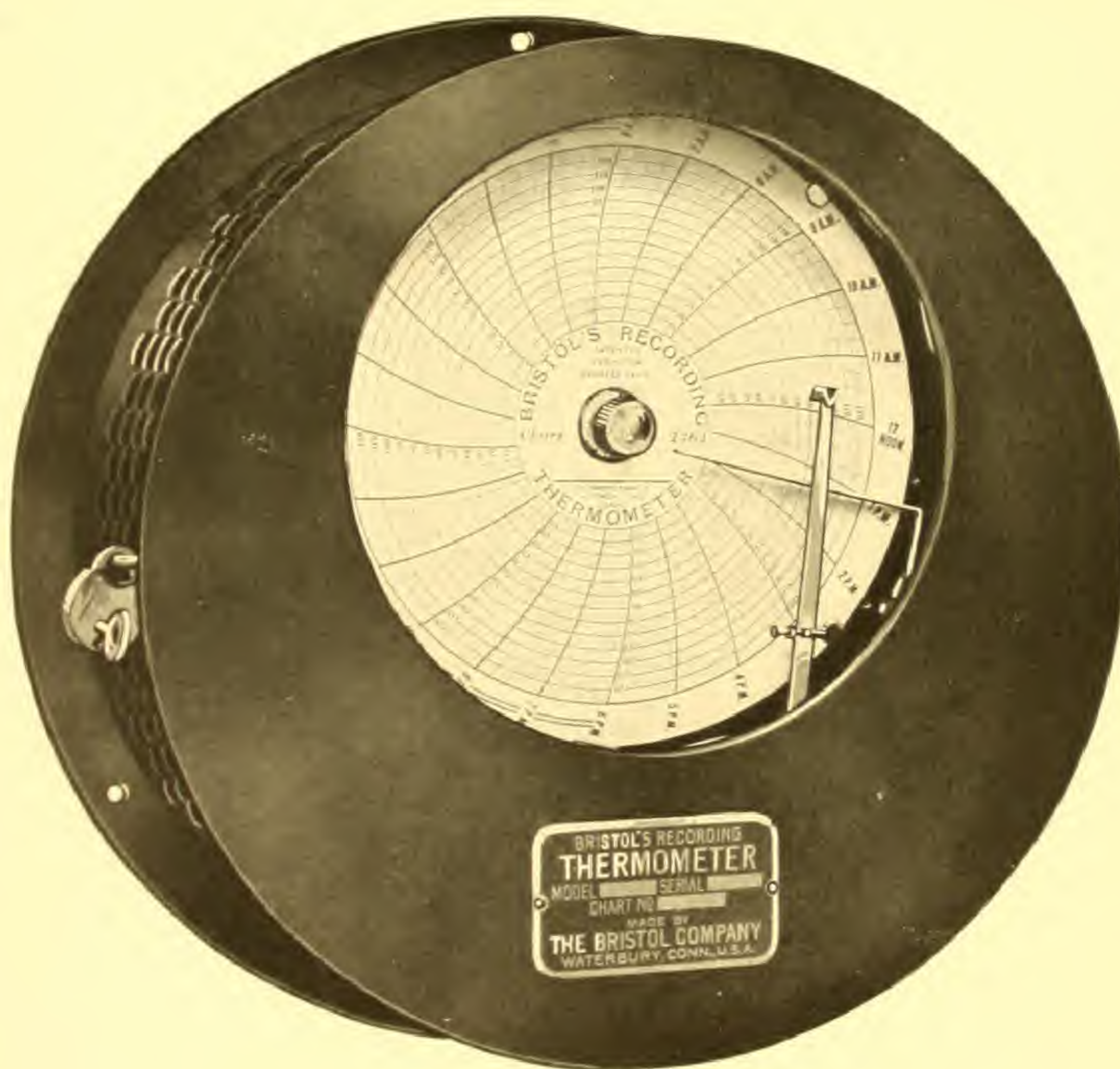


Fig. 1631

Although using the smaller diameter charts, this thermometer is designed and constructed with the same care as the larger instruments. While the larger charts are

recommended, the service which this instrument will give is thoroughly up to the usual Bristol standard. Standard finish of case is black enamel.

See Page 26 for List of Charts

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

**RECORDING THERMOMETER, PORTABLE MODEL 146**  
**WITH SELF-CONTAINED BULB**  
(Used with 6-Inch Charts Only)

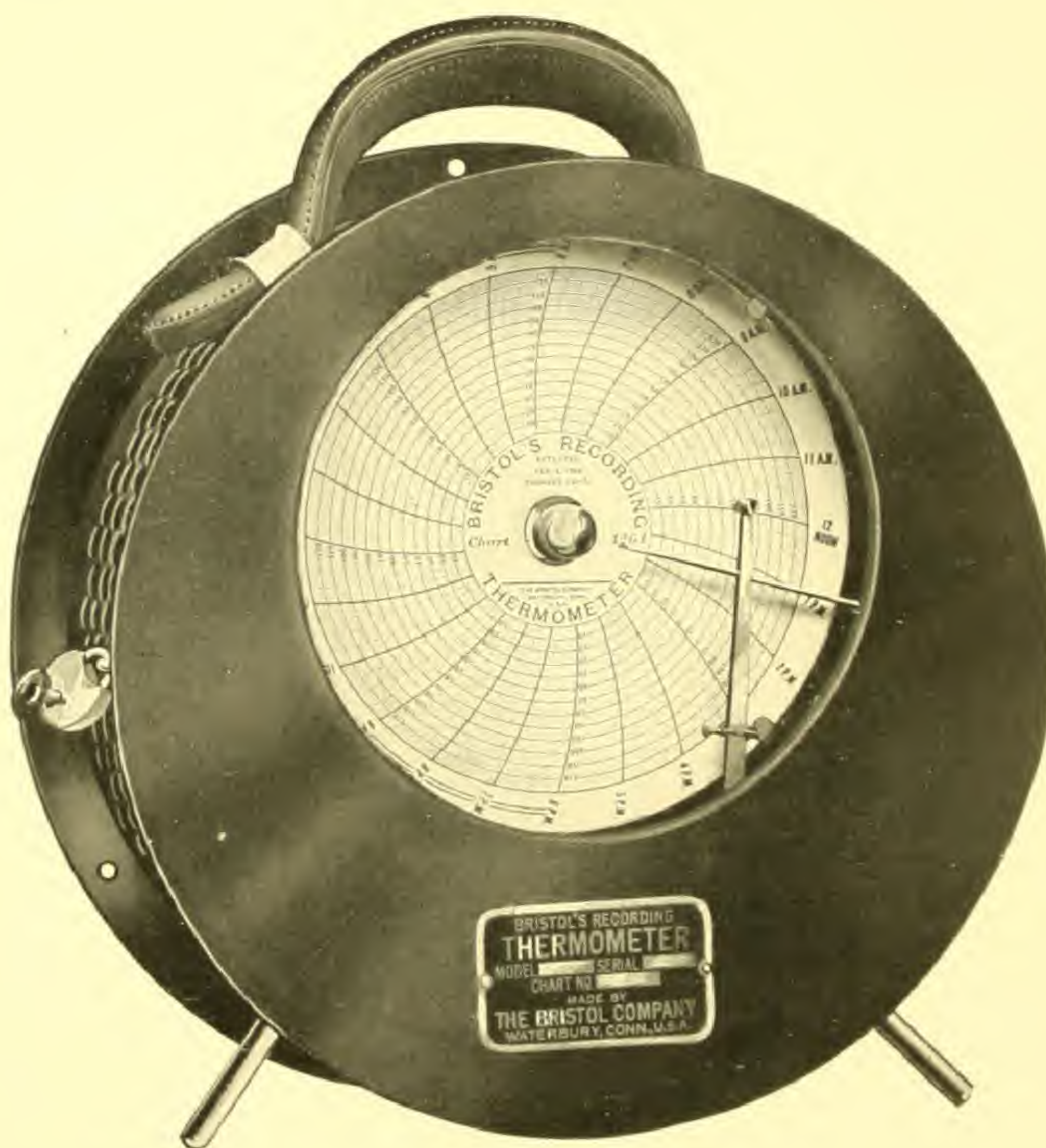


Fig. 1630

This portable instrument is extensively used for investigative work, not requiring the larger size of charts. It is a durable instru-

ment, well designed and constructed. Standard finish of case is black enamel, and has a leather handle for carrying.

See Page 26 for List of Charts



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

**RECORDING THERMOMETER, PORTABLE MODEL 164**  
**WITH UNION BULB AND CONNECTING TUBE**  
(Used with 6-Inch Charts Only)

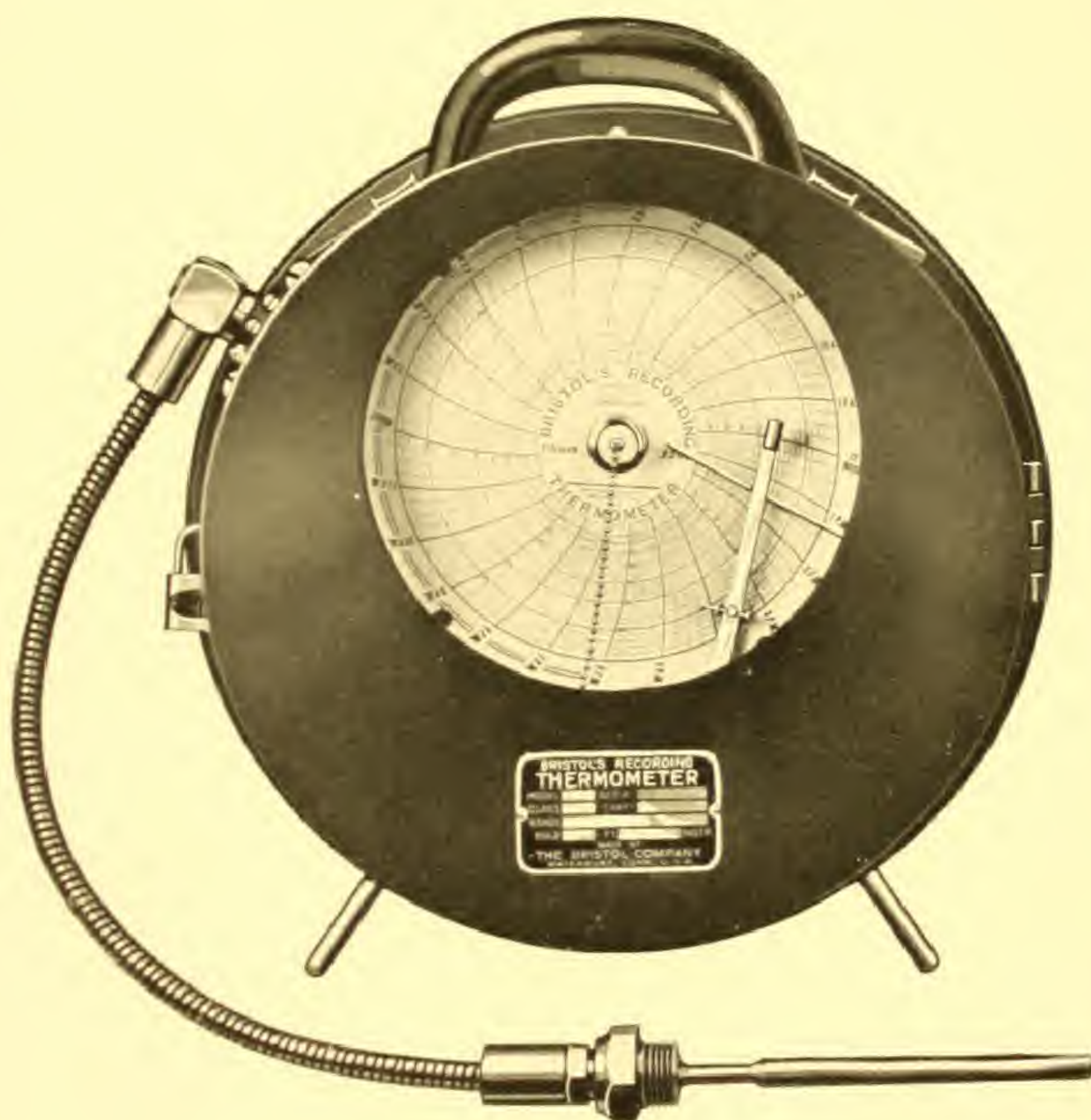


Fig. 2559

This instrument is equipped for portable service, having leather carrying handle and feet to support in standing position. Also included with the equipment is three feet of flexible connecting tube between the instrument and sensitive bulb No. 122, which

is  $\frac{3}{8}$  inch in diameter and has  $\frac{1}{2}$  inch union. This style of bulb makes it possible to use the thermometer for recording temperatures in closed spaces, such as pipe lines, tanks, etc. Standard finish of case is black enamel.

See Page 26 for List of Charts

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

**RECORDING THERMOMETER, MODEL 147**  
**REAR-EXTENSION BULB, FIXTURE No. 13**  
(Used with 6-Inch Charts Only)

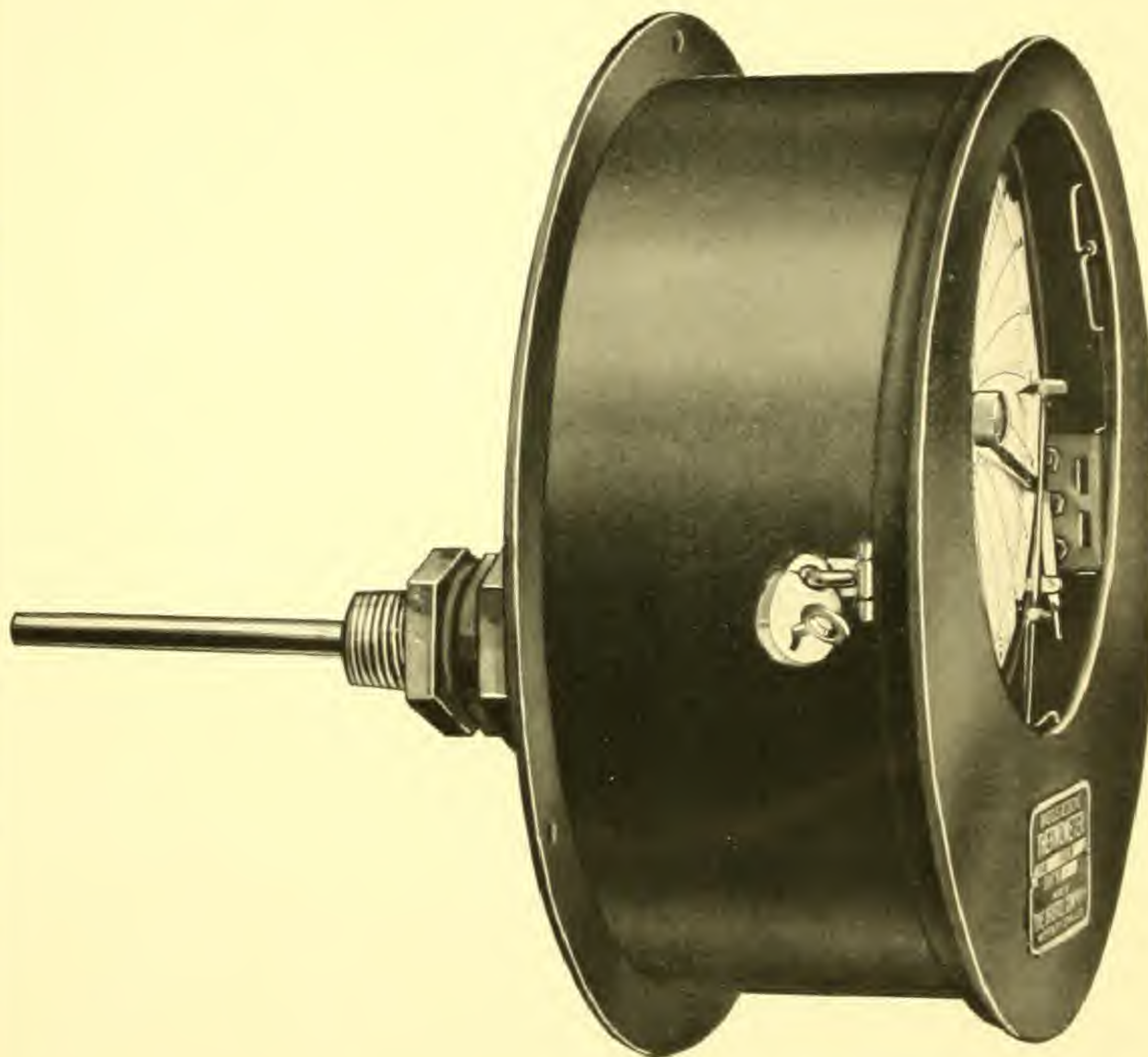


Fig. 1632

Model 147, with rear-extension bulb, Fixture No. 13, shown above, has been designed for recording temperatures in closed spaces under pressure, such as pipes, mains and tanks, when it is convenient to install

the recording instrument close to the point where the temperature is to be measured. The rear-extension bulb, Fixture No. 13, is equipped with a union connection. Standard finish of case is black enamel.

See Page 26 for List of Charts



## AUTOMATIC ELECTRIC ALARM

Used with Bristol's Recording Thermometers



Fig. 2167

Alarm Bell, to warn of too high or too low temperatures can be furnished to automatically operate from Bristol's Recording Thermometers. Such an alarm is used to inform the operator of the approaching danger point, and is often a very important addition to the regular service rendered by the recording instrument.

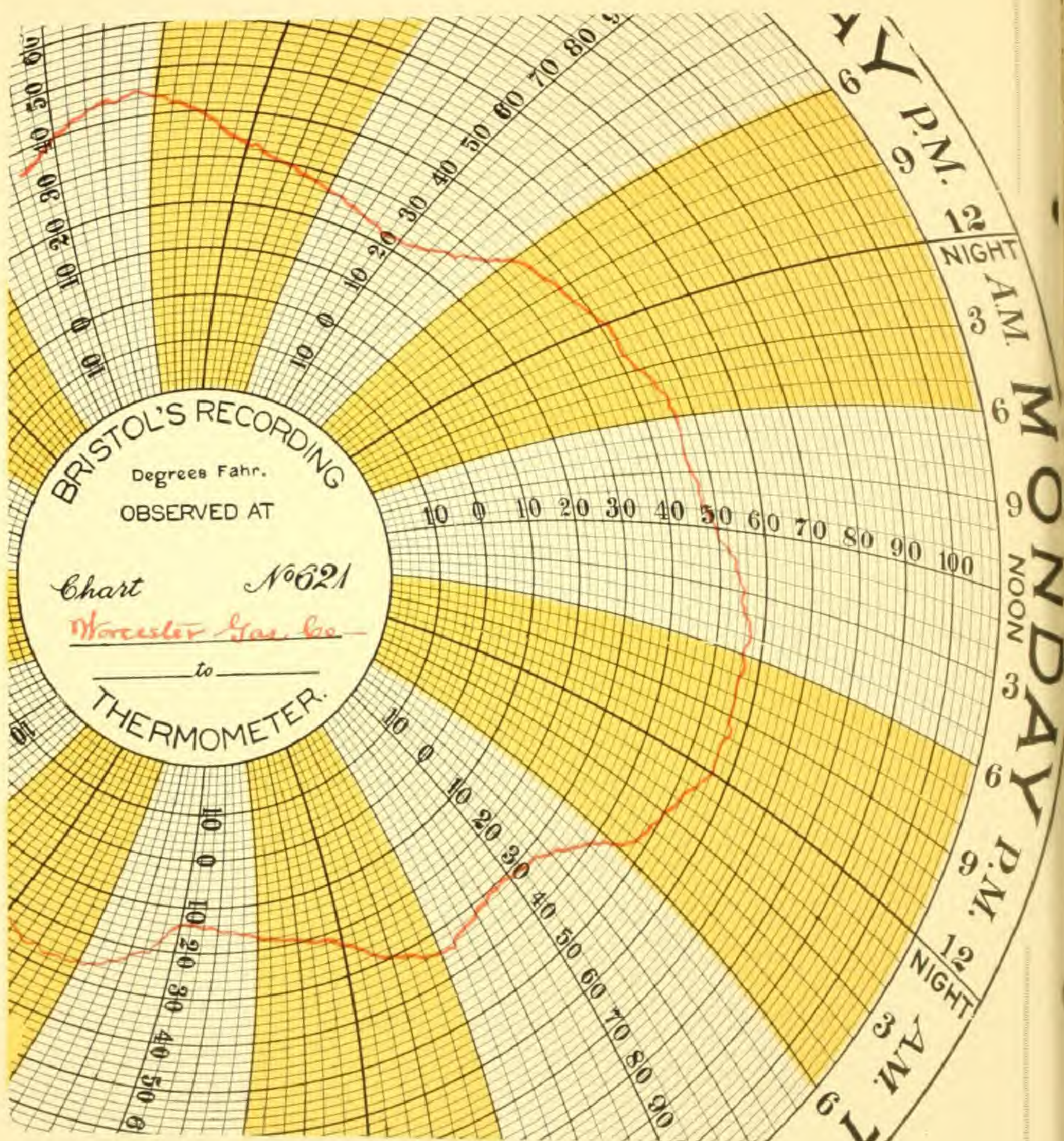
Only the external parts of the electric alarm are shown here—including bell, dry battery and bell wire. The equipment inside the instrument consists of a contact device installed back of the dial, so arranged to make contact at two points (high and low) on the scale. These contact points are adjustable and can be changed as desired, within the scale range, to suit individual requirements. The only exception to using this is with Round Form Model 168, which

case does not provide sufficient room for adjustable contact; but permanent contact can be used with this model.

The bell is connected to the recorder by ordinary wire and is operated by current from Dry Cell Battery. Contacts can also be furnished to operate from lighting circuit 110 volt A. C. or D. C. and when necessary 220 volts. When used with D. C. a special bell is required for which an additional charge is made. With A. C. a transformer must be used and can also be furnished if desired.

When Automatic Electric Alarm Attachment is required, it should be specified on order with instrument; it cannot be satisfactorily installed outside of the laboratory. Recording Thermometers now in the field should be returned to the factory to be equipped with Electric Alarm Attachment.





Full-size fac-simile section of 12-inch, 7-day Chart No. 621 with record of atmospheric temperature. It will be noted that the portions of the chart devoted to the night hours between 6 P. M. and 6 A. M. are

darker colored, thus making it an easy matter to distinguish between the day and night records. 12-inch charts, for use with the thermometers herein described, are listed on page 21.

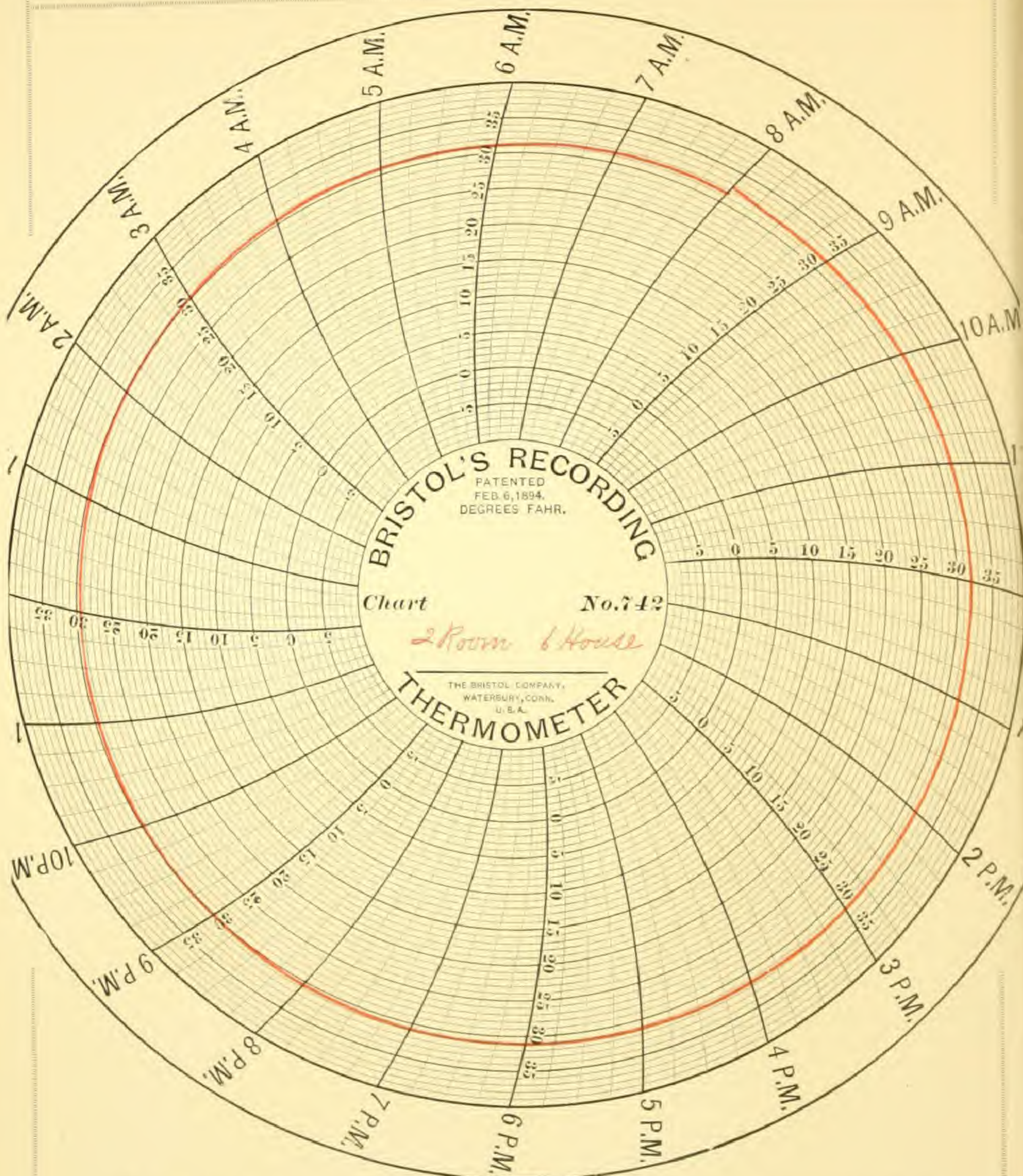


## 12-INCH CHARTS

### For Use with Models 111, 112 and 140

Chart No.	Each Grad.	Working Range	Total Range	One Rev. of Chart	Specimen Sections of Charts
732	2°	10-0- 70° F.	10-0- 90° F. (Reversed)	24 Hrs.	
3647	1°	40 to 80° F.	40 to 90° F.	7 Dys.	
781	1°	40 to 80° F.	40 to 90° F.	24 Hrs.	
3699	2°	40 to 80° F.	40-0-100° F. (Reversed)	7 Dys.	
3694	1°	0 to 80° F.	0 to 100° F.	7 Dys.	
734	2°	0 to 80° F.	0 to 100° F.	24 Hrs.	
780	2°	0 to 80° F.	0 to 100° F.	8 Hrs.	
771	1°	20 to 85° F.	20 to 100° F. (Reversed)	24 Hrs.	
773	2°	10 to 85° F.	10 to 110° F. (Reversed)	24 Hrs.	
621	2°	20-0- 85° F.	20-0- 110° F.	7 Dys.	
645	2°	20-0- 85° F.	20-0- 110° F.	24 Hrs.	
3688	2°	20-0- 85° F.	20-0- 110° F.	12 Hrs.	
738	1°	40 to 90° F.	40 to 110° F.	24 Hrs.	
3610	2°	0 to 120° F.	0 to 150° F.	7 Dys.	
778	2°	0 to 120° F.	0 to 150° F.	24 Hrs.	
3677	2°	30-0- 130° F.	30-0- 150° F.	7 Dys.	
793	2°	30-0- 130° F.	30-0- 150° F.	24 Hrs.	
758	2°	40 to 130° F.	40 to 160° F.	7 Dys.	
3672	2°	40 to 130° F.	40 to 160° F.	24 Hrs.	
3609	1°	0 to 25° C.	0 to 30° C.	7 Dys.	
751	1°	30-0- 30° C.	30-0- 45° C.	7 Dys.	





Full-size fac-simile 8-inch, 24-hour chart with record of temperature in egg storage room of large cold storage warehouse, show-

ing remarkably uniform temperature maintained.



## 8-INCH CHARTS

### For Use with Models 111, 112 and 140

Chart No.	Each Grad.	Working Range	Total Range	One Rev. of Chart	Specimen Sections of Charts
742	1°	10-0- 25° F.	10-0- 40° F.	24 Hrs.	
3627	1°	10 to 50° F.	10 to 60° F.	7 Dys.	
3600	2°	30-0- 45° F.	30-0- 70° F.	7 Dys.	
741	2°	30-0- 45° F.	30-0- 70° F.	24 Hrs.	
3628	1°	35 to 75° F.	35 to 85° F.	7 Dys.	
706	2°	0 to 80° F.	0 to 100° F.	7 Dys.	
707	2°	0 to 80° F.	0 to 100° F.	24 Hrs.	
3614	2°	0 to 80° F.	0 to 100° F.	12 Hrs.	
799	1°	50 to 90° F.	50 to 100° F.	7 Dys.	
3603	1°	50 to 90° F.	50 to 100° F.	24 Hrs.	
3698	2°	40-0- 90° F.	40-0-110° F.	7 Dys.	
3652	2°	40-0- 90° F.	40-0-110° F.	24 Hrs.	
709	2°	20-0- 90° F.	20-0-120° F.	7 Dys.	
648	2°	20-0- 90° F.	20-0-120° F.	24 Hrs.	
3656	5°	20-0- 90° F.	20-0-120° F.	48 Hrs.	
3684	2°	0 to 110° F.	0 to 130° F.	7 Dys.	
701	5°	0 to 110° F.	0 to 130° F.	24 Hrs.	
752	2°	30 to 110° F.	30 to 130° F.	7 Dys.	
787	2°	30 to 110° F.	30 to 130° F.	24 Hrs.	
3623	2°	30 to 110° F.	30 to 130° F.	8 Hrs.	
3637	2°	40 to 115° F.	40 to 140° F.	7 Dys.	
719	2°	40 to 115° F.	40 to 140° F.	24 Hrs.	
722	5°	0 to 110° F.	0 to 150° F.	24 Hrs.	
735	2°	50 to 120° F.	50 to 150° F.	24 Hrs.	
763	1°	18-0- 40 C.	18-0- 54° C.	24 Hrs.	
744	2°	0 to 40° C.	0 to 56° C.	7 Dys.	
768	2°	0 to 40° C.	0 to 56° C.	24 Hrs.	

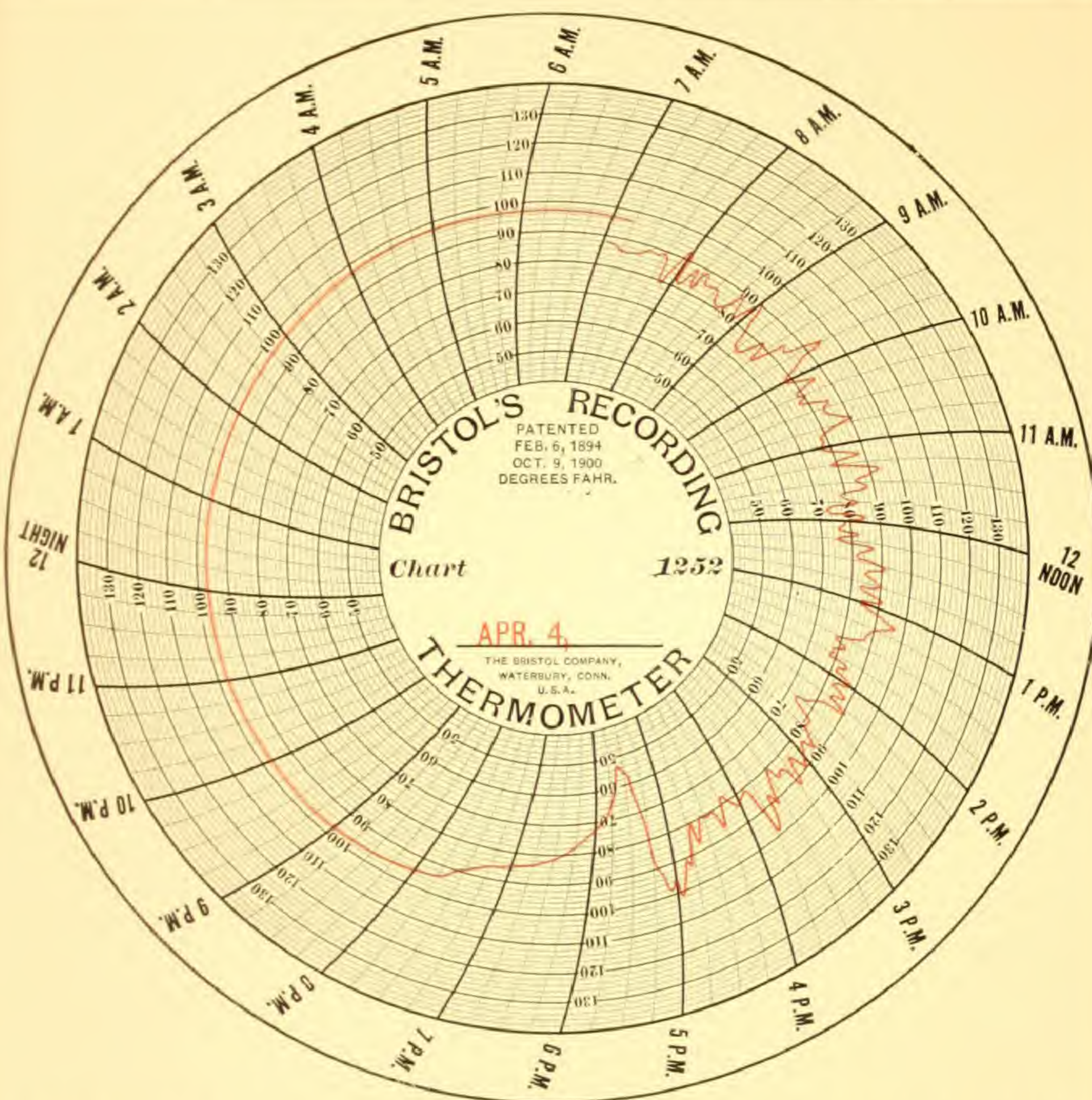


# 10-INCH AND 8-INCH CHARTS

For Use with Models 162, 168 and 169

Chart No.	Size of Chart Inches	Range	One Rev. of Chart	Specimen Sections of Charts
10205	10	0 to 60° F.	7 Dys.	
10210	10	30-0-120° F.	7 Dys.	
10207	10	30 to 150° F.	24 Hrs.	
8211	8	30-0- 70° F.	24 Hrs.	
1703	8	0 to 100° F.	7 Dys.	
1702	8	0 to 100° F.	24 Hrs.	
8202	8	20-0-110° F.	24 Hrs.	
8203	8	35-0-110° F.	7 Dys.	
8208	8	30-0-120° F.	24 Hrs.	
8205	8	30 to 220° F.	24 Hrs.	
1704	8	10-0- 40° R.	7 Dys.	
1705	8	15-0- 15° C.	7 Dys.	





### FULL SIZE FAC-SIMILE 6-INCH CHART WITH RECORD OF HOT WATER TEMPERATURES.

The record reproduced on Chart No. 1252 above is a record of temperature of hot water used for washing hides in a tannery. It will be noted that during working hours of the day the temperatures fluctuated quite rapidly and that the maximum is 100° and the minimum is 50°. This temperature record was secured with a Bristol Recording Thermometer by a customer who had installed a hot water temperature regulator and wished to secure an exact record of the temperature so

as to know whether the regulator was actually regulating the temperature and holding same practically constant at the desired point. It is understood that in this instance the capacity of the hot water apparatus to which the regulator was applied was not large enough to suit the requirements, and this partly accounts for the fact that the temperature was found to fluctuate beyond the desired limits.



## 6-INCH CHARTS

For Use with Models 146, 147, 148 and 164

Chart No.	Each Grad.	Working Range	Total Scale	One Rev. of Chart	Specimen Sections of Charts
1254	1°	10 to 45° F.	10 to 60° F.	24 Hrs.	
1262	2°	-30 to 0 to 45° F. (Reversed)	-30 to 0 to 70° F. (Reversed)	7 Dys.	
1279	2°	-30 to 0 to 45° F.	-30 to 0 to 70° F.	24 Hrs.	
1258	2°	-10 to 0 to 70° F. (Reversed)	-10 to 0 to 90° F. (Reversed)	24 Hrs.	
1271	1°	40 to 80° F.	40 to 90° F.	24 Hrs.	
1270	2°	0 to 80° F.	0 to 100° F.	7 Dys.	
1250	2°	0 to 80° F.	0 to 100° F.	24 Hrs.	
1272	2°	-20 to 0 to 90° F.	-20 to 0 to 110° F.	7 Dys.	
1253	2°	60 to 100° F.	60 to 110° F.	7 Dys.	
1267	2°	70 to 110° F.	70 to 120° F.	7 Dys.	
1261	2°	0 to 110° F.	0 to 130° F.	24 Hrs.	
1252	2°	40 to 125° F.	40 to 140° F.	24 Hrs.	
1277	2°	50 to 130° F.	50 to 150° F.	72 Hrs.	
1265	2°	10 to 130° F.	10 to 150° F.	7 Dys.	



## DETAILS FOR ORDERING BRISTOL'S CLASS I. RECORDING THERMOMETERS

(This information will help to secure the most suitable equipment for your particular requirements)

1. **MODEL NUMBER.**
2. **FINISH OF CASE** (if other than standard).
3. **RANGE.**  
Maximum and minimum temperatures, also average working temperature which will be required to measure.
4. **CHART NUMBER.**  
Give chart number if listed. The charts most often used are listed in this catalog. If they do not fully meet with your requirements, be sure to give details as per items Nos. 4, 6 and 7; also any further data possible.
5. **SIZE OF CHART.**  
12-inch, 10-inch, 8-inch or 6-inch.
6. **CLOCK OR REVOLUTION.**  
7-day, 24-hour, 12-hour, or 1-hour. Most of the charts listed in this catalog are for 7-day or 24-hour.
7. **BULB OR FIXTURE.**
8. **FLEXIBLE CONNECTING TUBE.**  
3 feet of tubing is the standard length with the Class I. Recording Thermometers. When longer lengths are involved, temperature conditions at the instrument, bulb, and of parts of the tubing must be given.
9. **APPLICATION.**  
It will greatly help in selecting the correct equipment to know the exact application where instrument will be installed, also the conditions in regard to surroundings where it will be located. Is there excessive moisture or dust in the atmosphere? Are there sudden changes of temperature in the room or any other unusual conditions?

## SHIPPING WEIGHTS BRISTOL'S CLASS I. RECORDING THERMOMETERS

Model No.		Size	Package Dimensions in Inches	Net Weight	Gross Weight, DOMESTIC	Gross Weight, FOREIGN
111	Self Contained	12-Inch	29 x 19 x 12	18 Lbs.	35 Lbs.	40 Lbs.
111	Self Contained	8-Inch	23 x 13 x 12	13 Lbs.	30 Lbs.	35 Lbs.
111	Fixture No. 15	12-Inch	29 x 16 x 14	19 Lbs.	50 Lbs.	55 Lbs.
111	Fixture No. 15	8-Inch	24 x 14 x 12	14 Lbs.	40 Lbs.	45 Lbs.
111	Fixture No. 13	12-Inch	29 x 19 x 12	20 Lbs.	40 Lbs.	42 Lbs.
111	Fixture No. 13	8-Inch	23 x 13 x 12	15 Lbs.	35 Lbs.	36 Lbs.
111	3 feet Tubing	12-Inch	29 x 19 x 12	14 Lbs.	35 Lbs.	40 Lbs.
111	3 feet Tubing	8-Inch	23 x 13 x 12	19 Lbs.	30 Lbs.	35 Lbs.
112	Fixture No. 15	12-Inch	30 x 25 x 12	23 Lbs.	50 Lbs.	52 Lbs.
112	Fixture No. 15	8-Inch	24 x 18 x 10	18 Lbs.	40 Lbs.	42 Lbs.
140	Fixture No. 15	12-Inch	29 x 19 x 12	45 Lbs.	75 Lbs.	80 Lbs.
140	Fixture No. 15	8-Inch	25 x 18 x 11	31 Lbs.	60 Lbs.	64 Lbs.
140	3 feet Tubing	12-Inch	29 x 19 x 12	46 Lbs.	75 Lbs.	80 Lbs.
140	3 feet Tubing	8-Inch	25 x 18 x 11	32 Lbs.	60 Lbs.	64 Lbs.
146	Self Contained	6-Inch	16 x 13 x 10	10 Lbs.	20 Lbs.	26 Lbs.
147	Fixture No. 13	6-Inch	23 x 13 x 11	13 Lbs.	32 Lbs.	35 Lbs.
148	Self Contained	6-Inch	16 x 13 x 10	10 Lbs.	20 Lbs.	26 Lbs.
162	3 feet Tubing	10-Inch	25 x 18 x 11	14 Lbs.	32 Lbs.	35 Lbs.
162	3 feet Tubing	8-Inch	23 x 13 x 12	12 Lbs.	30 Lbs.	32 Lbs.
164	3 feet Tubing	6-Inch	23 x 13 x 12	13 Lbs.	28 Lbs.	30 Lbs.
168	Self Contained	10-Inch	23 x 14 x 12	14 Lbs.	32 Lbs.	35 Lbs.
168	Self Contained	8-Inch	23 x 13 x 12	12 Lbs.	30 Lbs.	32 Lbs.
169	Self Contained	10-Inch	23 x 13 x 12	14 Lbs.	30 Lbs.	32 Lbs.
169	Self Contained	8-Inch	25 x 18 x 11	12 Lbs.	32 Lbs.	35 Lbs.



## DRILLING DIMENSIONS

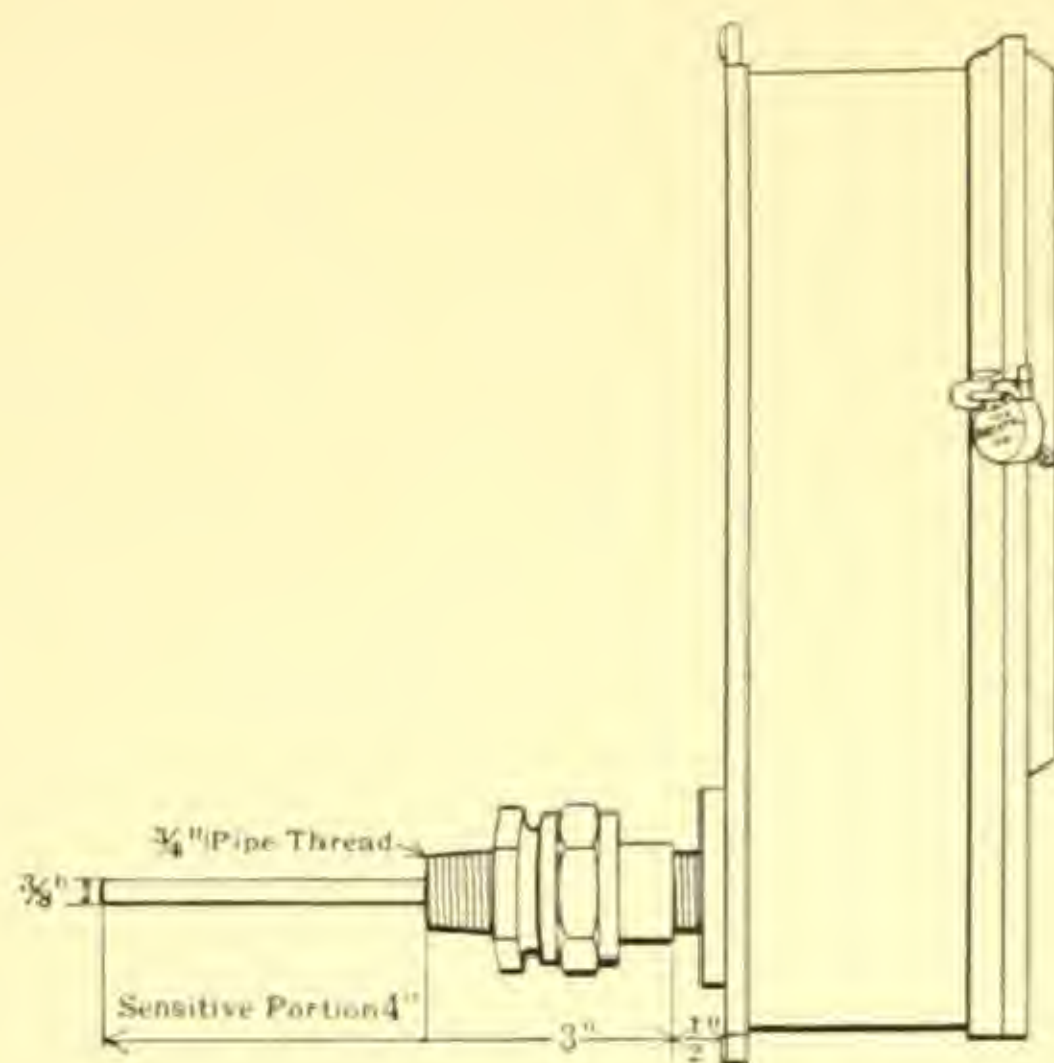


Fig. 1688

## Model 111, Fixture No. 13

As per Fig. 1685	C	D	E	F	Thread
Dimensions in Inches	4"	3/8"	3"	1/2"	3/4" Pipe

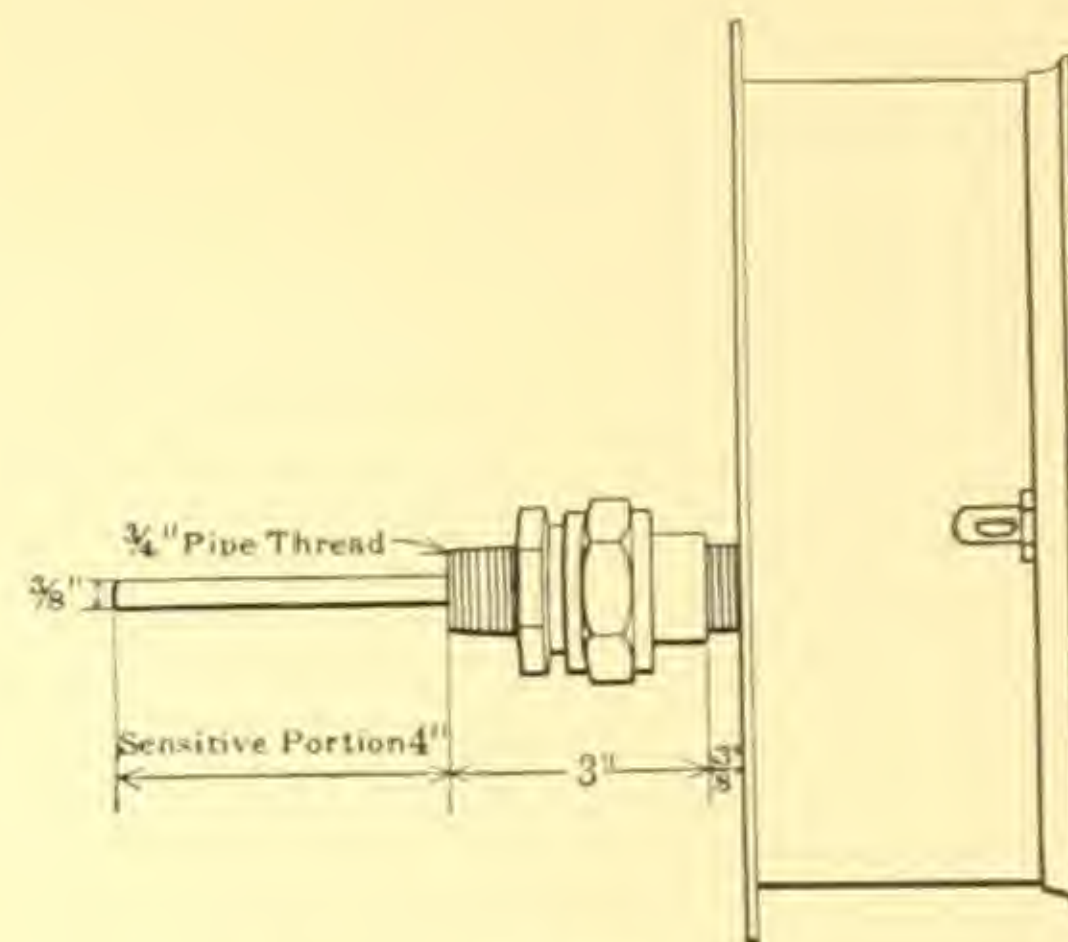


Fig. 1687

## Model 147, Fixture No. 13

As per Fig. 1687	C	D	E	F	Thread
Dimensions in Inches	4"	3/8"	3"	1/2"	3/4" Pipe

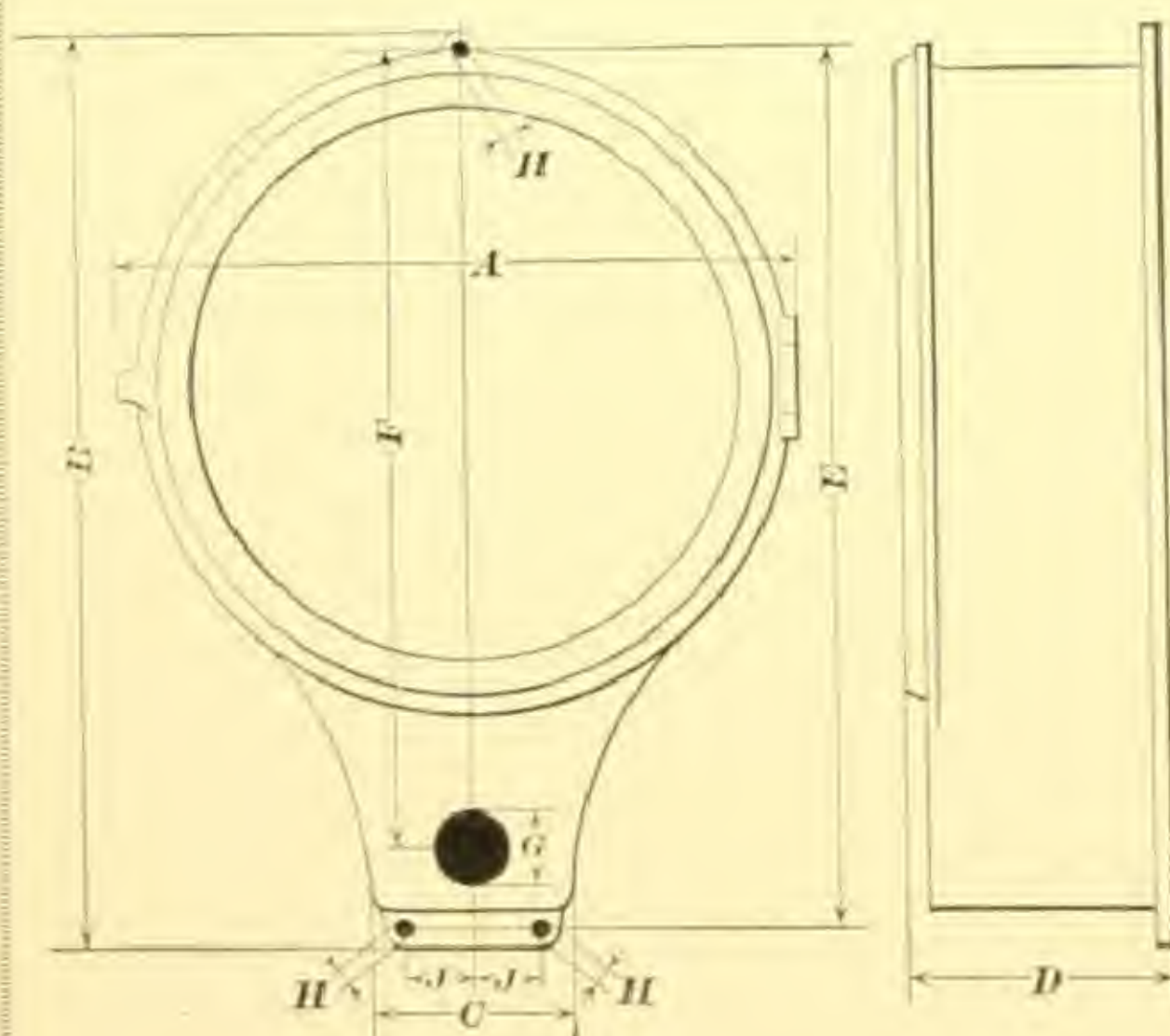


Fig. 174

Model 111, S. C. and with  
Connecting Tube

See page 29 for Dimensions.

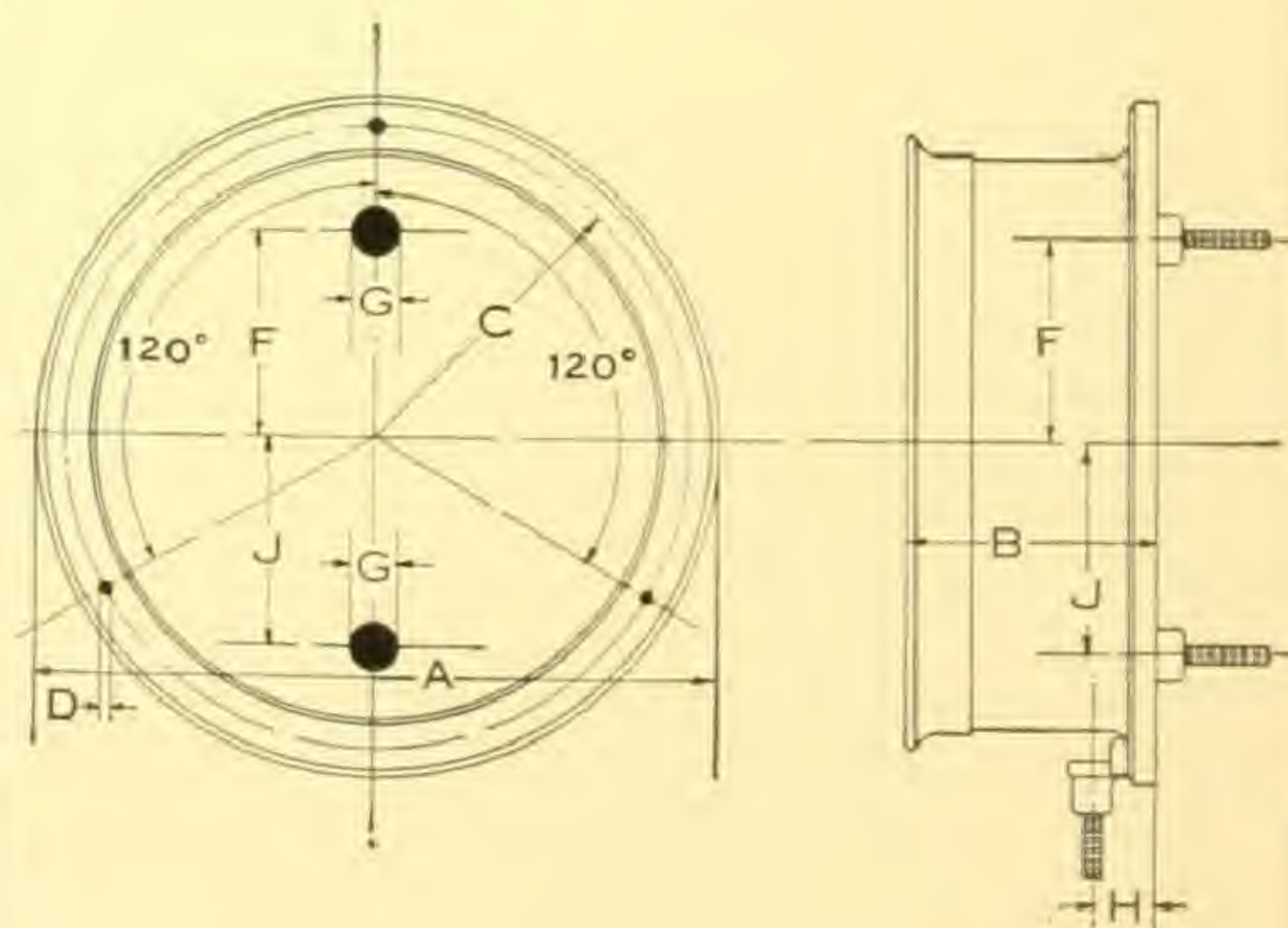


Fig. 2014

## Models 148 and 168

See page 29 for Dimensions.



## DRILLING DIMENSIONS

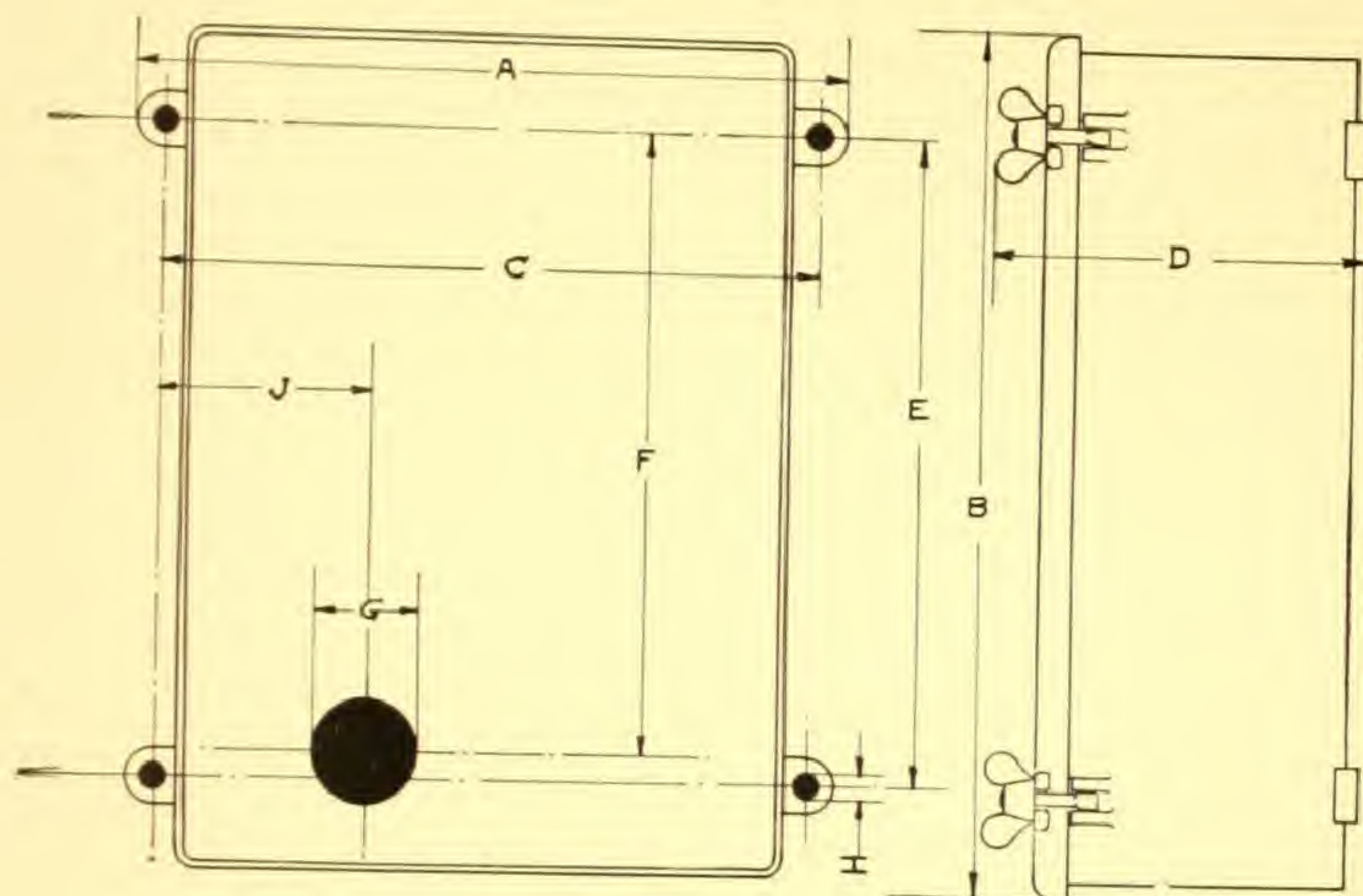


Fig. 1681

### Model 140

See Dimensions below.

Model No.	Size Chart	Figure No.	DIMENSIONS IN INCHES								
			A	B	C	D	E	F	G	H	J
111	12-Inch	174	13 <sup>15</sup> / <sub>16</sub> "	17 <sup>15</sup> / <sub>16</sub> "	4 <sup>1</sup> / <sub>8</sub> "	3 <sup>7</sup> / <sub>8</sub> "	17 <sup>9</sup> / <sub>16</sub> "	16 <sup>9</sup> / <sub>16</sub> "	Variable	1/4"	1 <sup>5</sup> / <sub>32</sub> "
111	8-Inch	174	10 "	13 <sup>1</sup> / <sub>4</sub> "	3 <sup>1</sup> / <sub>8</sub> "	3 <sup>7</sup> / <sub>8</sub> "	12 <sup>11</sup> / <sub>16</sub> "	11 <sup>11</sup> / <sub>16</sub> "	Variable	1/4"	1 "
140	12-Inch	1681	14 <sup>5</sup> / <sub>8</sub> "	18 "	13 <sup>1</sup> / <sub>2</sub> "	5 <sup>1</sup> / <sub>2</sub> "	12 <sup>3</sup> / <sub>8</sub> "	13 "	Variable	3/8"	3 <sup>1</sup> / <sub>4</sub> "
140	8-Inch	1681	11 "	13 "	9 <sup>7</sup> / <sub>8</sub> "	4 <sup>3</sup> / <sub>4</sub> "	9 <sup>7</sup> / <sub>8</sub> "	9 <sup>9</sup> / <sub>16</sub> "	Variable	3/8"	2 <sup>3</sup> / <sub>4</sub> "
148	6-Inch	2014	10 <sup>5</sup> / <sub>8</sub> "	3 <sup>3</sup> / <sub>4</sub> "	6 <sup>1</sup> / <sub>16</sub> "	1/4"	—	—	Variable	1 <sup>1</sup> / <sub>16</sub> "	5 "
168	8-Inch	2014	10 <sup>5</sup> / <sub>8</sub> "	3 <sup>3</sup> / <sub>4</sub> "	4 <sup>29</sup> / <sub>32</sub> "	1/4"	—	—	Variable	1 <sup>1</sup> / <sub>16</sub> "	3 <sup>9</sup> / <sub>16</sub> "
168	10-Inch	2014	12 <sup>3</sup> / <sub>4</sub> "	3 <sup>3</sup> / <sub>4</sub> "	6 <sup>1</sup> / <sub>16</sub> "	1/4"	—	—	Variable	1 <sup>3</sup> / <sub>16</sub> "	5 "

NOTE: For inverted models, invert the diagram.



### ACCURATE CHARTS NECESSARY

Every Recording Thermometer is calibrated to be used with the particular chart specified. This makes it necessary that every chart must be identical without even the slightest variation, in order to insure accuracy. For this reason, every attention is given to the finest details which make Bristol's charts absolutely accurate and reliable under all conditions.

Even the paper on which Bristol's Charts are printed is made specially for the purpose. The charts are printed in our own plant from extremely accurate engravings, and under uniform humidity conditions.

The accuracy of Bristol's Recording Thermometers cannot be guaranteed unless genuine Bristol's Charts are used. To identify them, every round chart is printed on paper having water mark reading "Bristol's" and the name of The Bristol Company printed in the center.

### CHART REPLACEMENTS

With every new round chart instrument a supply of 100 charts is included. Additional replacements can be obtained at any time. When ordering, always specify chart number and kind of instrument.

Bristol's Round Charts are sold by the hundred. When placing order, specify by the hundred or multiple thereof. If otherwise specified, we reserve the right to change the quantity to the nearest multiple of one hundred.

For convenience, Bristol's Round Charts for ink recording are packed in boxes containing 100 each. This facilitates delivery, provides an inexpensive means of filing, and insures clean unmutated charts.



Fig. 2404

Round Charts are packed 100 to the box. Order by the hundred or multiple thereof, as broken lots are not sold.



Fig. 2405

### SPECIAL INK FOR RECORDING INSTRUMENT

In addition to the charts, Ink is the only other supply required. With each recording instrument a one-ounce bottle of ink is included. This is packed in a carton complete with glass dropper, as illustrated.

The ink is specially prepared to use with Bristol's Recording Instruments. Ordinary commercial writing ink containing a high percentage of acid is not suitable, because it is quick-drying and has a tendency to corrode metals. This special Bristol's Recording Instrument Ink is slow-drying, and one filling of the pen insures a perfect record for one complete revolution of the chart.

The Special Dropper holds just enough ink for one filling of the pen. This avoids the use of too much ink, which would overflow and cause smudgy records. It is particularly important when used by careless workmen, or those unaccustomed to handling the finer grade of tools.

### COLORS OF INK

Red is the standard color of Bristol's Special Recording Instrument Ink and is always furnished unless otherwise specified. However, when required for more than one record on the same chart or for other reasons, the following colors—blue, black, green, brown, yellow, orange and violet can be furnished at the same price as quoted. When other than red ink is desired, be sure to specify color.

### CHART HOLDER



Fig. 2403

When charts with records are to be filed for future reference, the Chart Holder like that shown provides a convenient method. They can be furnished for wall or shelf use.



## LIST PRICES

*For Use in Connection with Catalog No. 1104*

### BRISTOL'S CLASS I, RECORDING THERMOMETERS

Prices given below are for Standard Finish Case and instrument equipped with 24, 12 and 8-hour charts. When finished with 7-day charts add \$4.00 extra to List. With each instrument is included 100 Charts, Bottle of Bristol's Special Recording Instrument Ink, Padlock and Key.

Type of Bulb	Instrument Model No.	Shown on Page	LIST PRICE WITH CHART SIZE			
			12-Inch	10-Inch	8-Inch	6-Inch
Self-Contained.....	{111	5	\$61.00		\$50.00	
	{168	12		\$44.00	39.00	
	{169 (Portable)	14		45.00	40.00	
	{148	15				\$33.00
	{146 (Portable)	16				34.00
Extra Sensitive Fixture No. 15.....	{111	6	66.00		55.00	
	{112 (Portable)	9	72.00		61.00	
	{140	10	72.00		61.00	
Rear Ext. Type..... Fixture No. 13.....	{111	7	69.00		58.00	
	{147	18				42.00
*Bulb No. 102 shown on page 11, and with 3-ft. B.A.C.T.....	{111	8	72.00		61.00	
	{140	11	77.00		66.00	
	{162	13		66.00	60.00	
	{164	17				55.00

\*When equipped with Bulb No. 122, shown on page 17, add \$1.00 extra List.

\*When equipped with Bulb No. 182, shown on page 8, add \$2.00 extra List.

\*When equipped with Bulb No. 132, shown on page 13, add \$5.00 extra List.

### ALARM ATTACHMENT

Automatic Electric Alarm Attachment complete, including Bell, Dry Cell, 100 feet of Bell Wire, and Adjustable Contact Device, mounted and Adjusted to Bristol's Recording Thermometer..... \$25.00

Automatic Electric Alarm Attachment for use with lighting circuit. Prices quoted on request.

(OVER)

ELECTRICITY

MOTION, ETC.



## CHARTS

Bristol's Round Chart, 12-Inch and 10-Inch Diameter, per 100.....	\$1.65
Printed in copying ink, per 100.....	1.90
7-Day, printed in two colors, per 100.....	2.20
Onion-skin paper, per 100.....	2.75
Smoked surface, per 100.....	4.40
 Bristol's Round Chart, 8-Inch and 6-Inch Diameter, per 100.....	.80
Printed in copying ink, per 100.....	.95
7-Day, printed in two colors, per 100.....	1.35
Onion-skin paper, per 100.....	1.65
Smoked surface, per 100.....	2.75

## INK

Bristol's Special Recording Instrument Ink,	
One-ounce Bottle.....	.30
Two-ounce Bottle.....	.45
Four-ounce Bottle.....	.65
Half-pint Bottle.....	1.10
Pint Bottle.....	1.90
Quart Bottle.....	3.30
 Combination Rubber Stopper and Glass Filler.....	.10

## CHART HOLDERS

Chart Holder for 8-Inch Round Chart.....	2.20
Chart Holder for 12-Inch Round Chart.....	2.75

When ordering Chart Holders, specify whether for wall or shelf use.

All Prices on this page are F. O. B. Waterbury, Conn.



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## RECORDING THERMOMETER, MODEL 311

(For measuring outdoor atmosphere temperatures  
 with Recording Thermometer installed indoors)

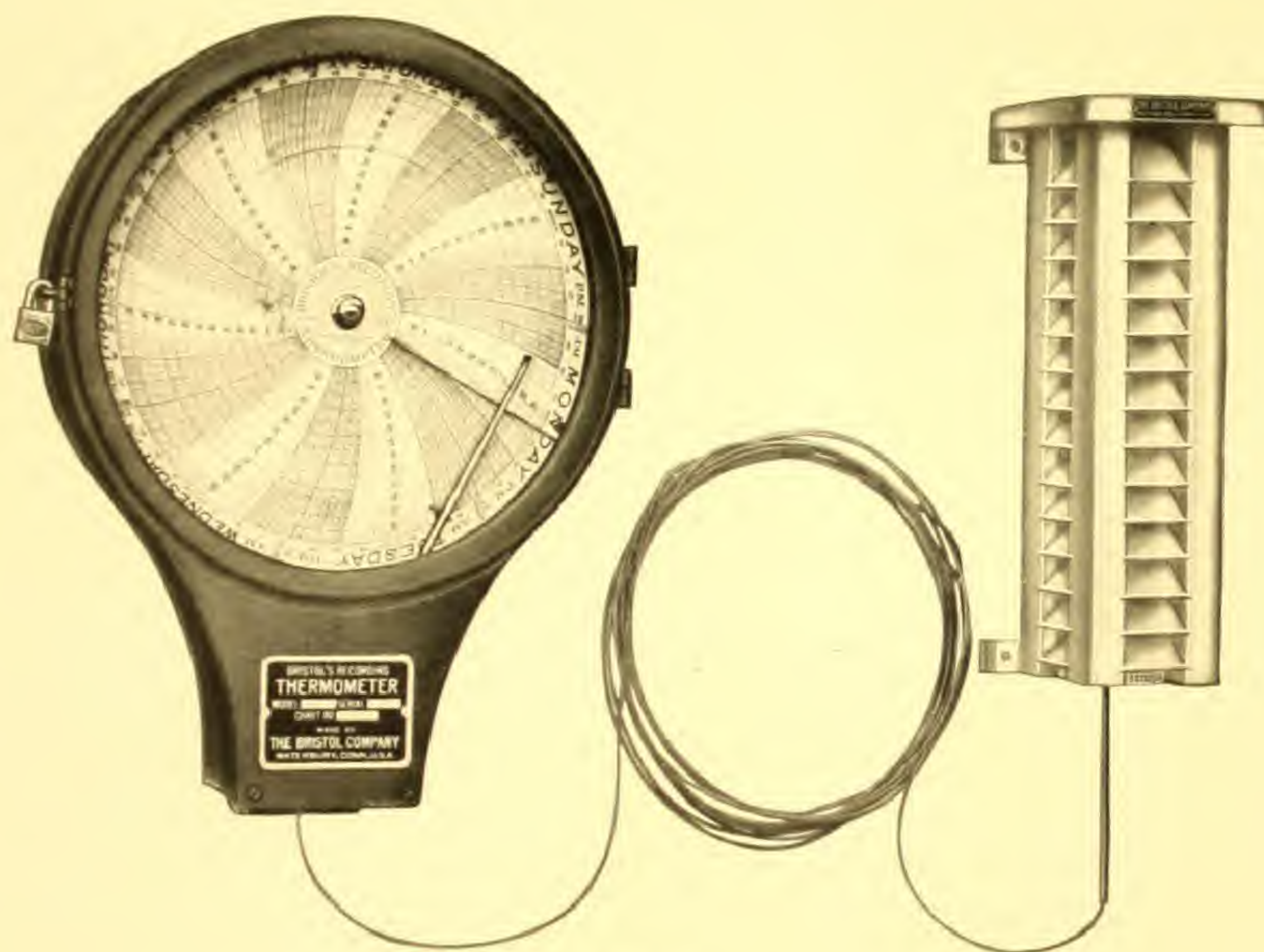


Fig. 2078

The instrument shown above differs from the Class I. Thermometer shown in this catalog, in that it is regularly furnished with 25 feet of flexible connecting tube between the instrument and the sensitive bulb. Longer lengths are also permissible when required.

This recording thermometer outfit is intended for recording outdoor atmospheric temperatures. It is so arranged that the instrument with the chart can be located inside the building, while the sensitive bulb is mounted outside in the latticed weather-

house, where it is exposed to the outside atmospheric temperature.

By being able to observe the outdoor temperature changes, it is possible to anticipate the demand upon heating and cooling systems, with the result that much greater economy and efficiency is obtained. For these reasons this type of recording thermometer is extensively used by hotels, apartment houses, manufacturing plants, public buildings, and in private residences.

A similar equipment can be furnished with two pens, so that the second pen records the indoor room temperatures.

ELECTRICITY

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### THE MOST EXTENSIVE LINE OF RECORDING INSTRUMENTS IN THE WORLD

**PRESSURE AND VACUUM**  
 Bristol's Recording Pressure and Vacuum Gauges

**LIQUID LEVEL**  
 Bristol's Recording Water Level Gauges  
 Bristol-Derr Water-Level Gauge for Steam Boilers

**TEMPERATURE**  
 Bristol's Class I. Recording Thermometers  
 Bristol's Class III. Recording Thermometers  
 Bristol's Class II. Recording Thermometers  
 Wm. H. Bristol Indicating and Recording Electric Pyrometers  
 Bristol's Temperature Controllers

**HUMIDITY**  
 Recording Wet and Dry Bulb Thermometers

**ELECTRICITY**  
 Bristol's Recording Voltmeters  
 Bristol's Recording Ammeters  
 Bristol's Recording Wattmeters  
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 Supplies for Bristol Recording Instruments  
 Bristol Engine Counters  
 Bristol Revolution Counters  
 Bristol-Durand Radil Averaging Instruments  
 Bristol Patent Safety Set Screws  
 Gaugeboard Clocks

**Bristol's Patent Steel Belt Lacing—The Perfect Fastener for All Kinds of Belts**



# THE BRISTOL COMPANY

WATERBURY, CONN., U. S. A.

## BRANCH OFFICES

Boston New York Philadelphia Birmingham Pittsburgh Detroit Chicago St. Louis Denver San Francisco

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The Bristol Company

No. 1203

## BRISTOL'S CLASS II RECORDING THERMOMETERS

For temperatures between 90° F and 500° F



Model 211

\*This Catalog supersedes No. 1202

ELECTRICITY

MOTION, ETC.



## INTRODUCTION

**T**HIS CATALOG is devoted exclusively to Bristol's Class II Recording Thermometers, which depend for their operation on the vapor pressure of a liquid and are called the "Vapor Tension" type. This type of instrument was first brought out by The Bristol Company about twenty-five years ago. In fact they were the first to use this principle in the construction of Recording Thermometers. Therefore, the instruments described are not an experiment, but a development resulting from years of experience.

### Construction

The instrument itself is really a pressure gauge. The pressure element is connected by a flexible capillary tubing to the sensitive bulb, which contains a liquid. When the bulb is heated, the liquid vaporizes and is passed through the system. The resulting pressure actuates the pressure element, which in turn operates the pen arm and traces the amount of pressure on a chart graduated in degrees of temperature. A high grade Seth Thomas clock movement, made specially for The Bristol Company, located directly back of the chart, causes the chart to revolve and thus a record is made which not only gives the temperatures maintained, but the time at which they occur.

### Range and Scale Characteristics

The standard Class II Thermometer is used for recording all degrees of temperature between 90° and 500° Fahrenheit or Centigrade equivalent. The chart scale graduations are always increasing and provide extra open and clear graduations over the working portion of the scale range. This is an advantage, especially where the maximum temperatures to be recorded are only a little higher than the average working temperature.

### Exterior Temperature Conditions

Any temperature to which the instrument itself or connecting tube may be exposed has no effect on the reading of the thermometer, providing, the temperature at the sensitive bulb is always higher than at any other point along the connecting tube or at the instrument.

### Instrument With Adjusted Bulb

Whenever a Class II Instrument is required to record temperatures lower than 90° F. or where the connecting tube and instrument will be subjected to temperatures higher than those at the sensitive bulb, a thermometer with "Adjusted Bulb" should be specified. This type of instrument is designed to accurately record all temperatures from about 30° F. and upward, covered by Class II Scale. This type of instrument varies from the Standard Class II Thermometer only in the size of bulb. The advantage is that the instrument and connecting tube are immune to external temperature conditions. The result is secured by using an exact amount of filling liquid and not by any auxiliary pressure springs in the instrument.

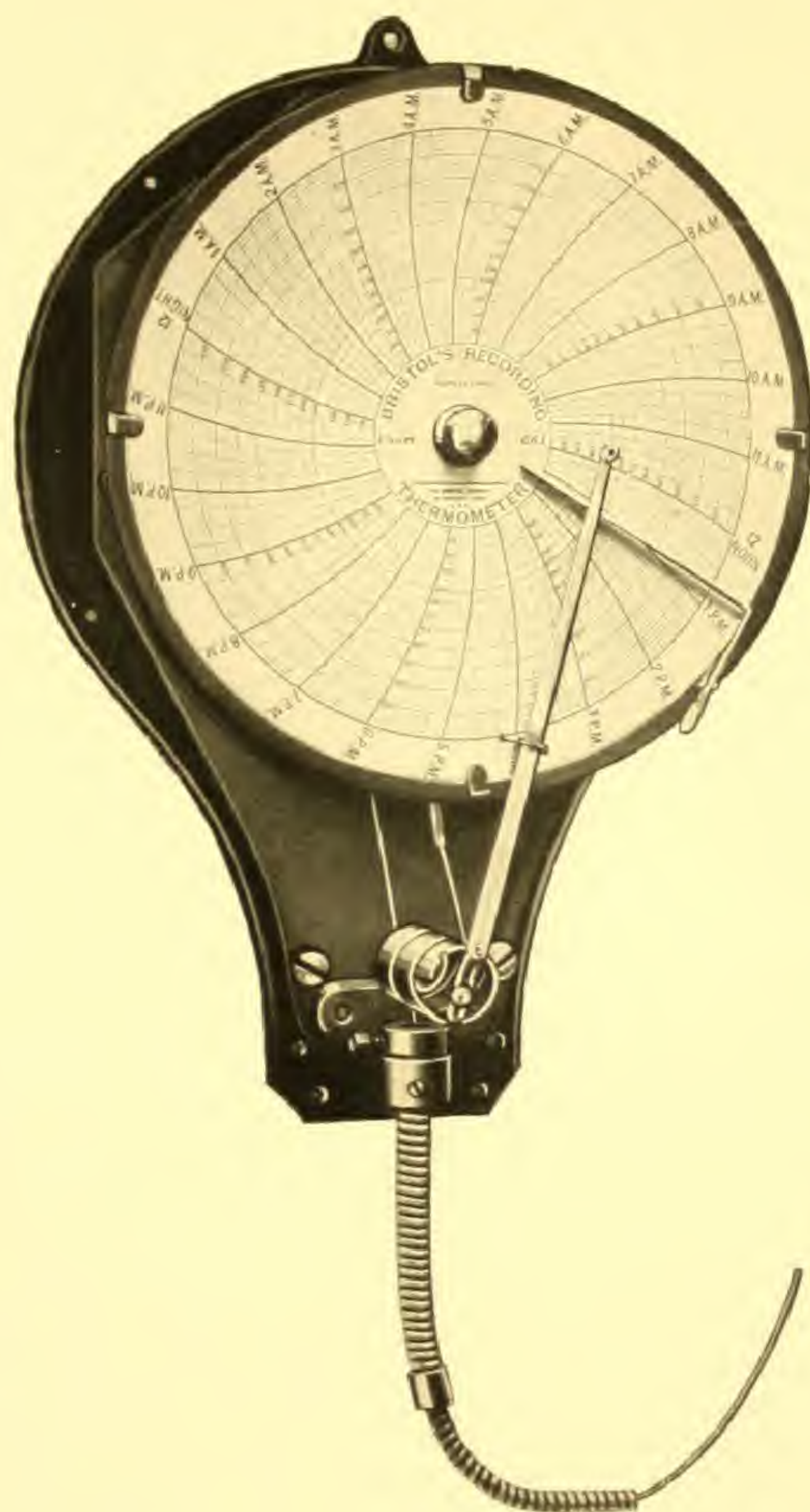
### Sensitivity

The vapor tension of the sensitive bulb of these Class II Thermometers responds almost instantly to changes of temperature at the bulb, making these thermometers extremely sensitive and positive in their action. Because of this extreme sensitivity they will record accurately even rapid fluctuations in temperature.

### Long Distance Feature

The flexible capillary connecting tube used between the sensitive bulb and recording instrument makes it possible to place the instrument at a convenient spot to be observed, while the sensitive bulb may be located at the point where it is required to measure the temperature. This is very often an inaccessible place and any other instrument without the long distance feature would be impossible to use. The standard length of connecting tube is 25-feet, but may be longer or shorter as required.





### Simplicity

Both the principle and design of Bristol's Class II Recording Thermometer is summed up in the one word, "Simplicity." The illustration above shows the interior construction and the absence of complicated mechanism, multiplying devices, etc., is a conspicuous feature. Even the pen arm is attached directly to the pressure element, and without any convolutions or additional support falls in a straight line to the pen point resting on the chart surface. Such extreme simplicity means little to get out of order, also reliability and long endurance without repairs.

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## RECORDING THERMOMETER MODEL 211



This is the model of instrument which is the one most generally recommended and used. You will see by referring to the interior construction shown on page 3 that the case has been designed to fit the working parts, thus they are not limited and cramped to conform to a more conventional design. The standard finish of the case is black enamel. Charts 12-inches and 8-inches in diameter listed on pages 18 to 22 are used with this model.

See Pages 40 and 41 for List Prices.



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## RECORDING THERMOMETER MODEL 211 IN DUST-PROOF WOODEN PROTECTION CASE



Although the instruments shown in this catalog are of a very rugged construction and designed for every day commercial work, it is sometimes advisable to use an extra protection from dust and atmospheric conditions. For this purpose a wooden protection case, as shown above can be supplied.

Wooden Protection Case, only, for 12-inch Model 211 .....	\$18.70 List
Wooden Protection Case, only, for 8-inch Model 211 .....	16.50 List

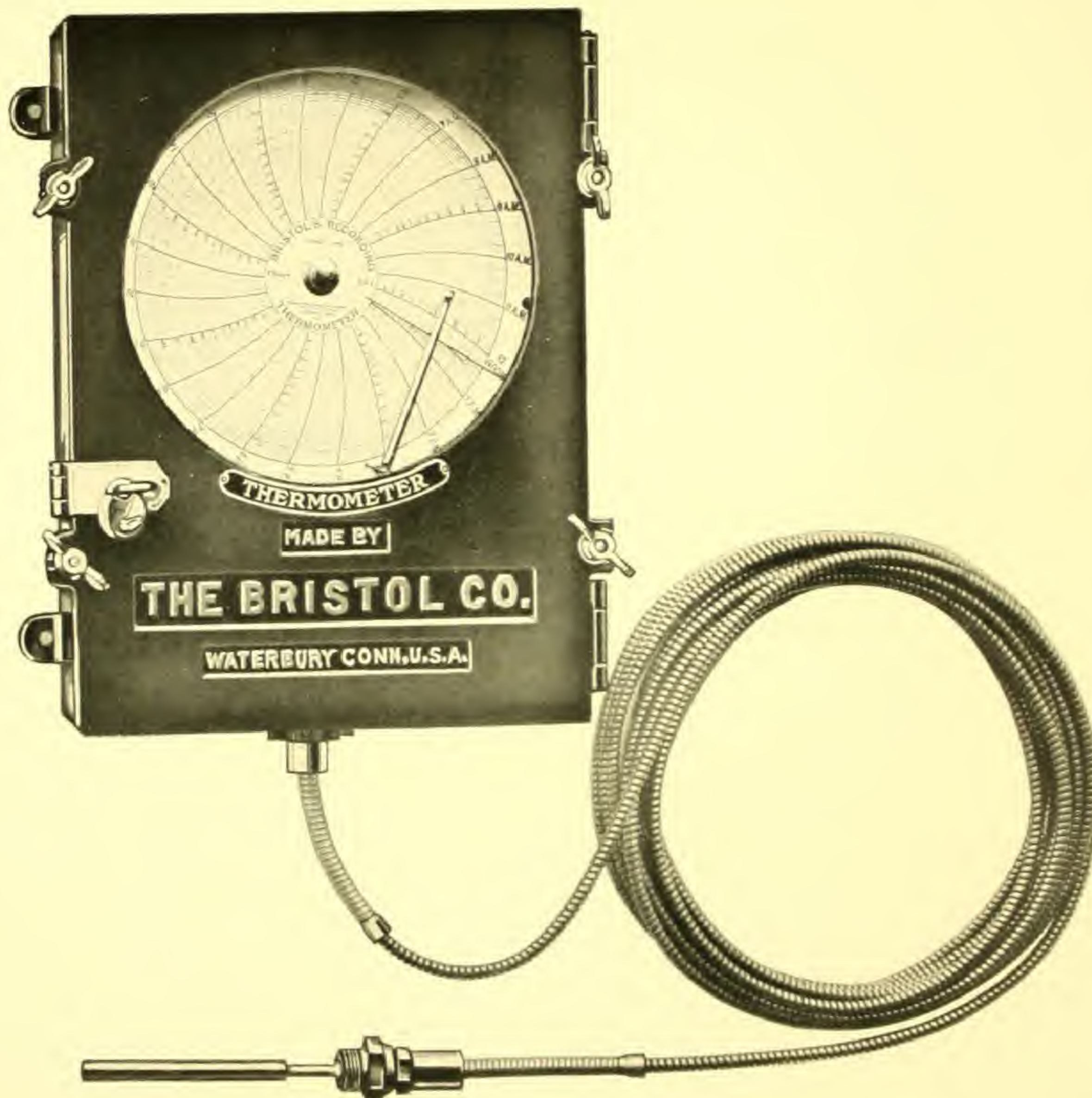
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## RECORDING THERMOMETER, MOISTURE-PROOF MODEL 240



The case shown above is made of cast iron and when closed is absolutely moisture-proof. Such a case is often required when the instrument will be exposed to dampness or corrosive vapors, as in chemical plants, pulp mills, etc.

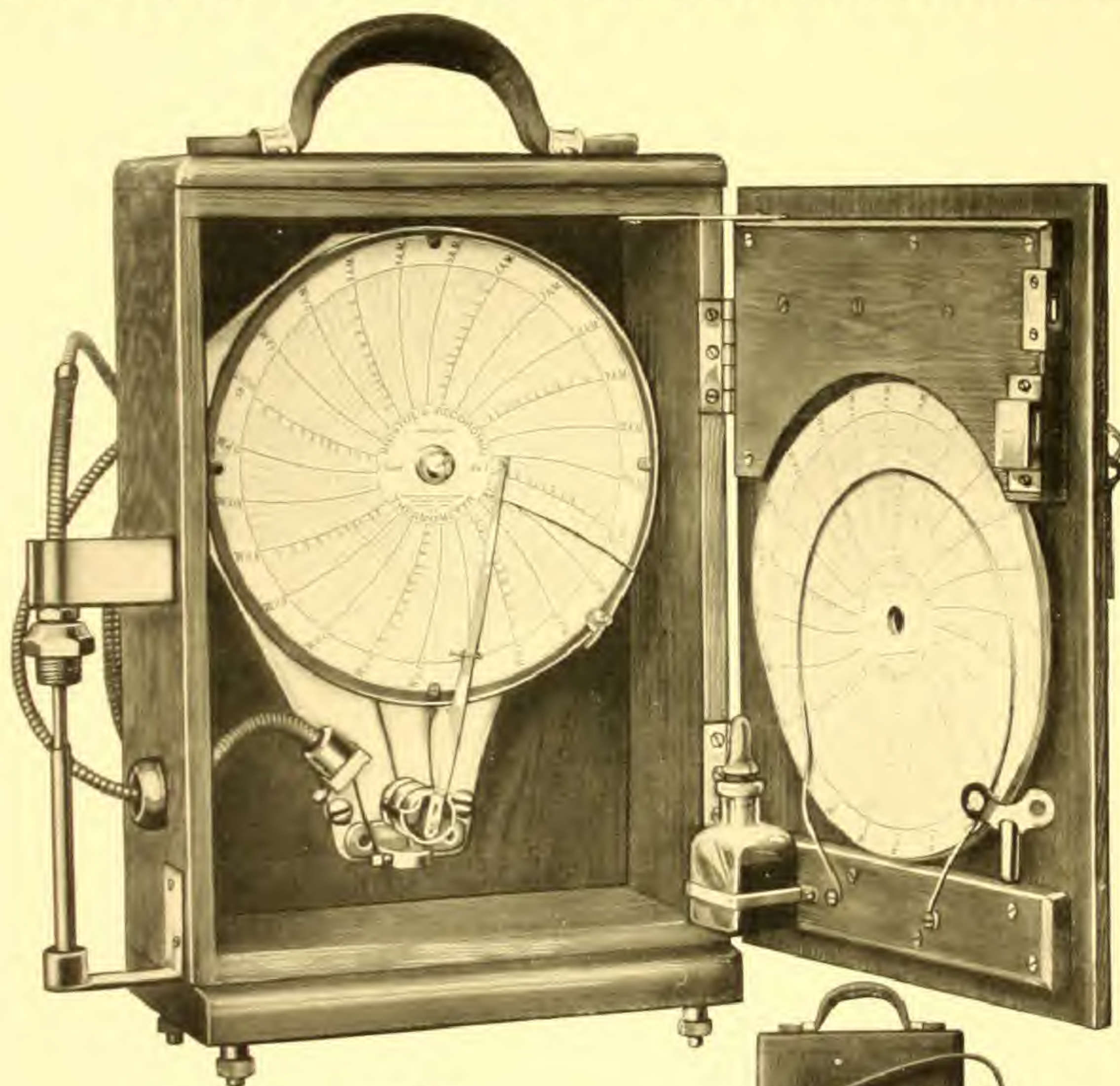
This is not an extra protection like the wooden case shown on page 5, but the same style of instrument as shown on page 3 is mounted in this cast iron moisture-proof case. The finish is black enamel. Charts 12-inches and 8-inches in diameter same as used with Model 211 are used with this Model 240.

See Pages 40 and 41 for List Prices.



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## RECORDING THERMOMETER PORTABLE MODEL 212



Front View

For experimental and test work this Portable Model Recording Thermometer has many important uses. The working parts are same as used in Model 211, also same charts 12-inch or 8-inch in diameter as listed on pages 18 to 22. The case is wood, therefore, light in weight and the arrangement is compact and convenient. Any bulb shown in this catalog can be supplied. Unless otherwise specified the thermometer is calibrated with bulb at same level as the instrument.



Rear View

See Pages 40 and 41 for List Prices.

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## RECORDING THERMOMETER, ROUND FORM MOISTURE-PROOF MODEL 241

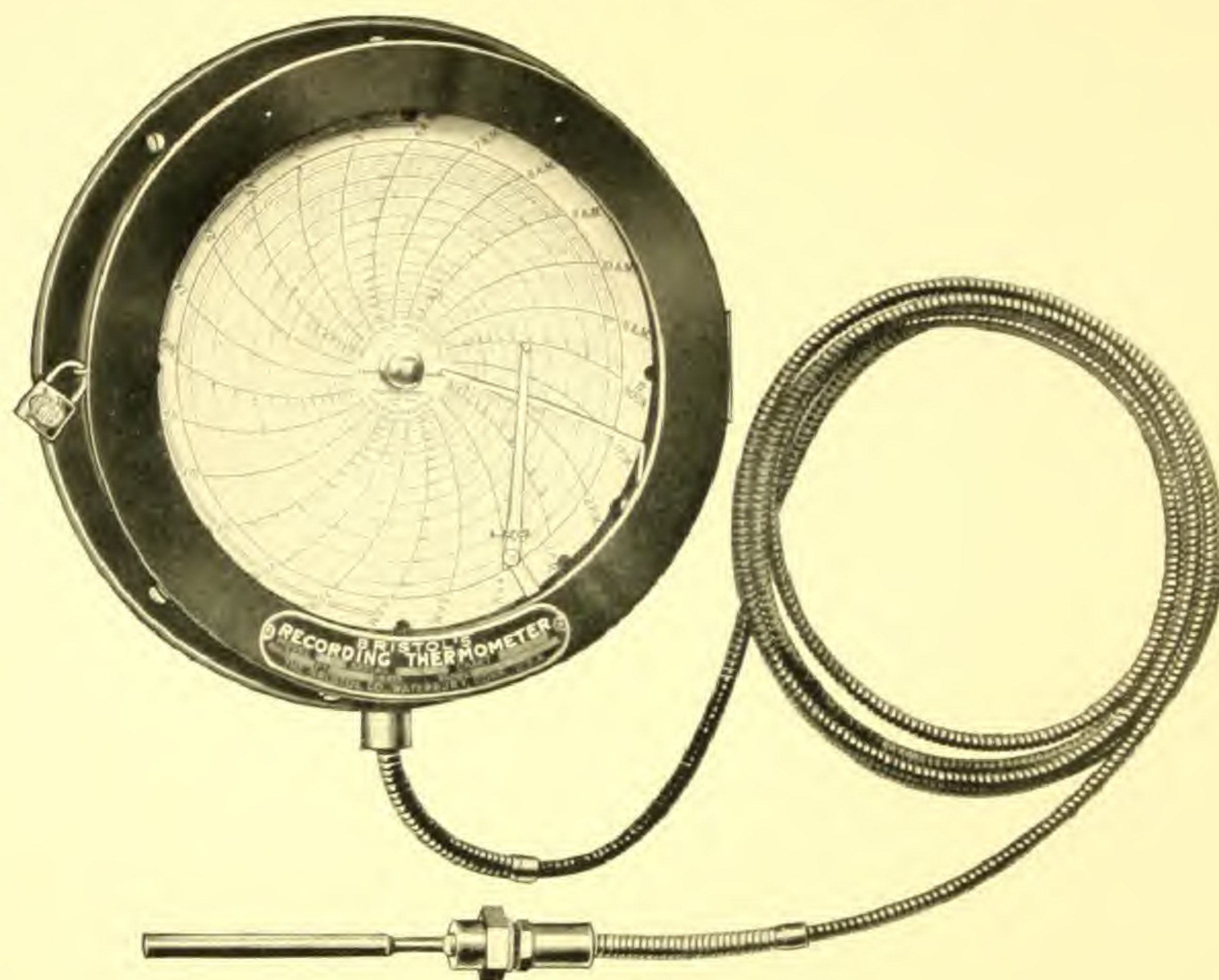


Figure 2011

Many installations require a round form of case where it is necessary to economize in space or to conform to specifications to match other instruments. The Model 241 shown above takes care of such requirements. Although the price of this instrument is lower than the standard Model 211 it embodies the features which make it a desirable and durable instrument where the round form case is required.

The Model 241 case is especially rugged and so constructed that it is moisture-proof and dust-proof. Because of these features the working parts of the instrument are well protected, and this model is particularly suited for applications where excessive moisture, dust or dirt are prevalent. The case is finished in black enamel.

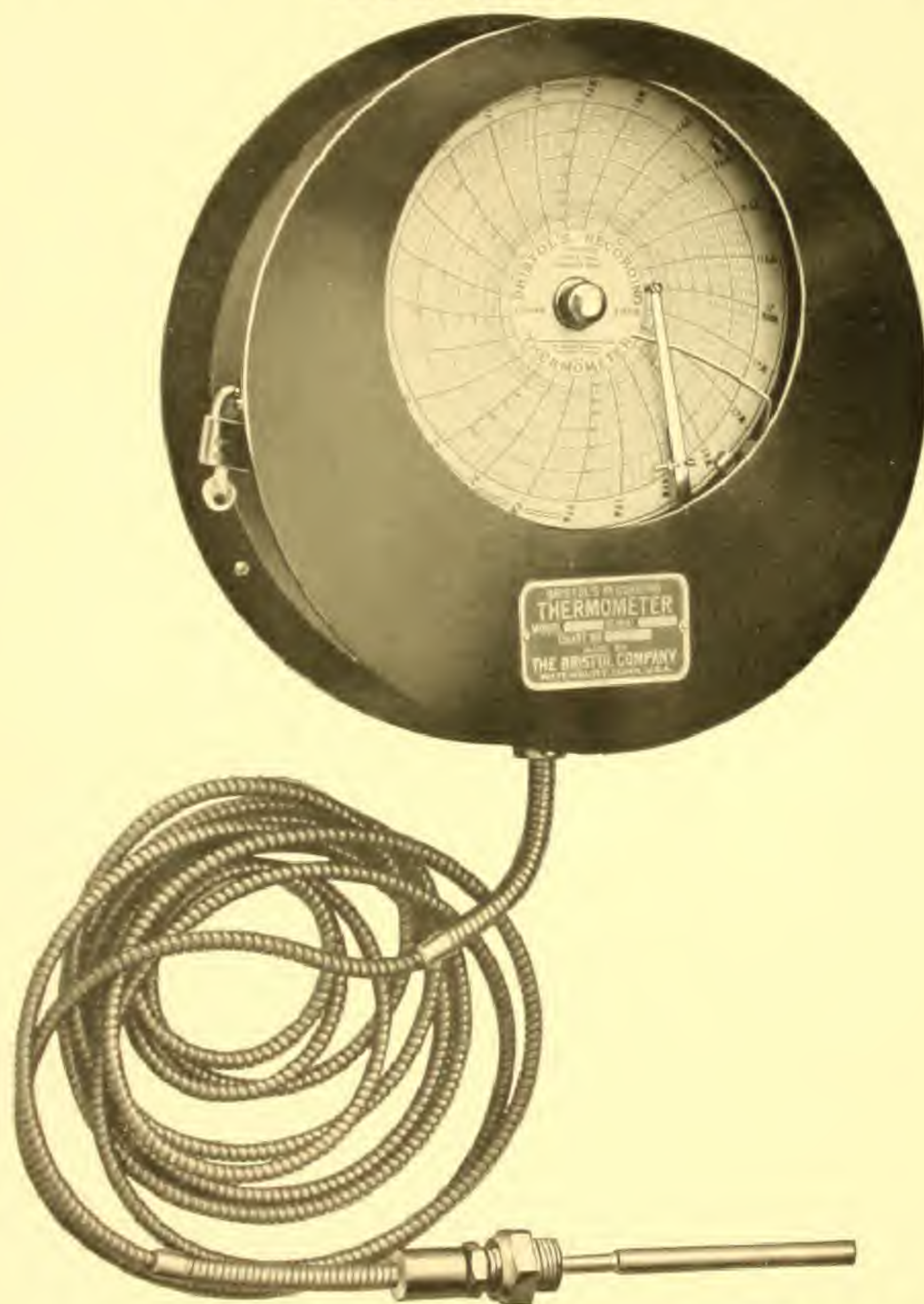
The charts used with this model are 10-inches and 8-inches in diameter as given in list on page 25.

**See Pages 40 and 41 for List Prices.**



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## RECORDING THERMOMETER, ECCENTRIC MODEL 247



Although the Model 247 Thermometer is usually referred to as the 6-inch chart instrument, in actual measurement, however, the charts used are 6½-inches in diameter. This instrument furnishes a very compact record and for many applications where it is not required to read the degrees of temperature too closely, fills every requirement for a recording thermometer.

The eccentric form of case permits the use of the same pressure element and affords very nearly as wide an angle of deflection as obtained in the Model 211. The price of Model 247 is lower than the other models, yet when used for the applications for which it is adapted is in every way a desirable instrument.

See Pages 40 and 41 for List Prices.

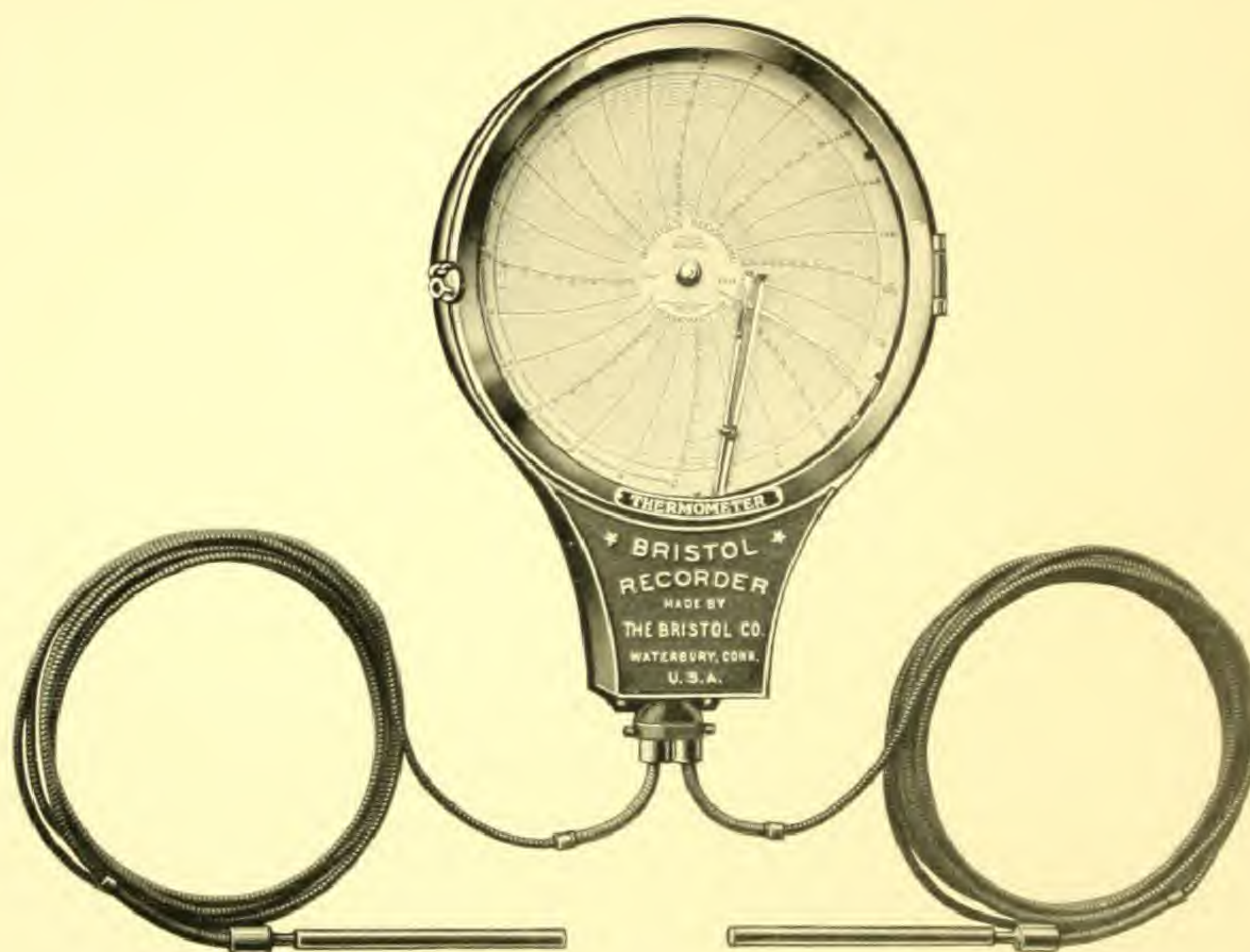
ELECTRICITY

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## RECORDING THERMOMETER MODEL 210 EQUIPPED WITH 2 PENS



This instrument consists of two complete recording thermometer operating units, mounted together in the same case and arranged to record on one chart. Such an equipment is often desirable where comparative records are wanted for use on two different operations of the same process.

To determine list price of double record thermometer instrument, multiply by  $(1\frac{3}{4})$  the price given for single record instrument of similar specifications.

See Pages 40 and 41 for List Prices.



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## RECORDING THERMOMETER MODEL 241 WITH ADJUSTED BULB



Figure 2004

The Class II Thermometer with Adjusted Bulb is designed to accurately record all temperatures ranging from about 30° F. to the highest covered by Class II scale. This instrument should be specified whenever a Class II is required to record temperatures lower than 90° F. or where the connecting tube and instrument will be subjected to temperatures higher than those at the sensitive bulb.

This instrument shown is Model 241 with Inverted Penarm, but any Model of Class II Thermometer can be furnished with Adjusted Bulb.

See paragraph "Instrument with Adjusted Bulb" on page 2.

For instrument with Adjusted Bulb, add \$5.50 extra list to price for similar bulb, given on pages 40-41.

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## RECORDING THERMOMETER MODEL 241 INVERTED PEN TYPE

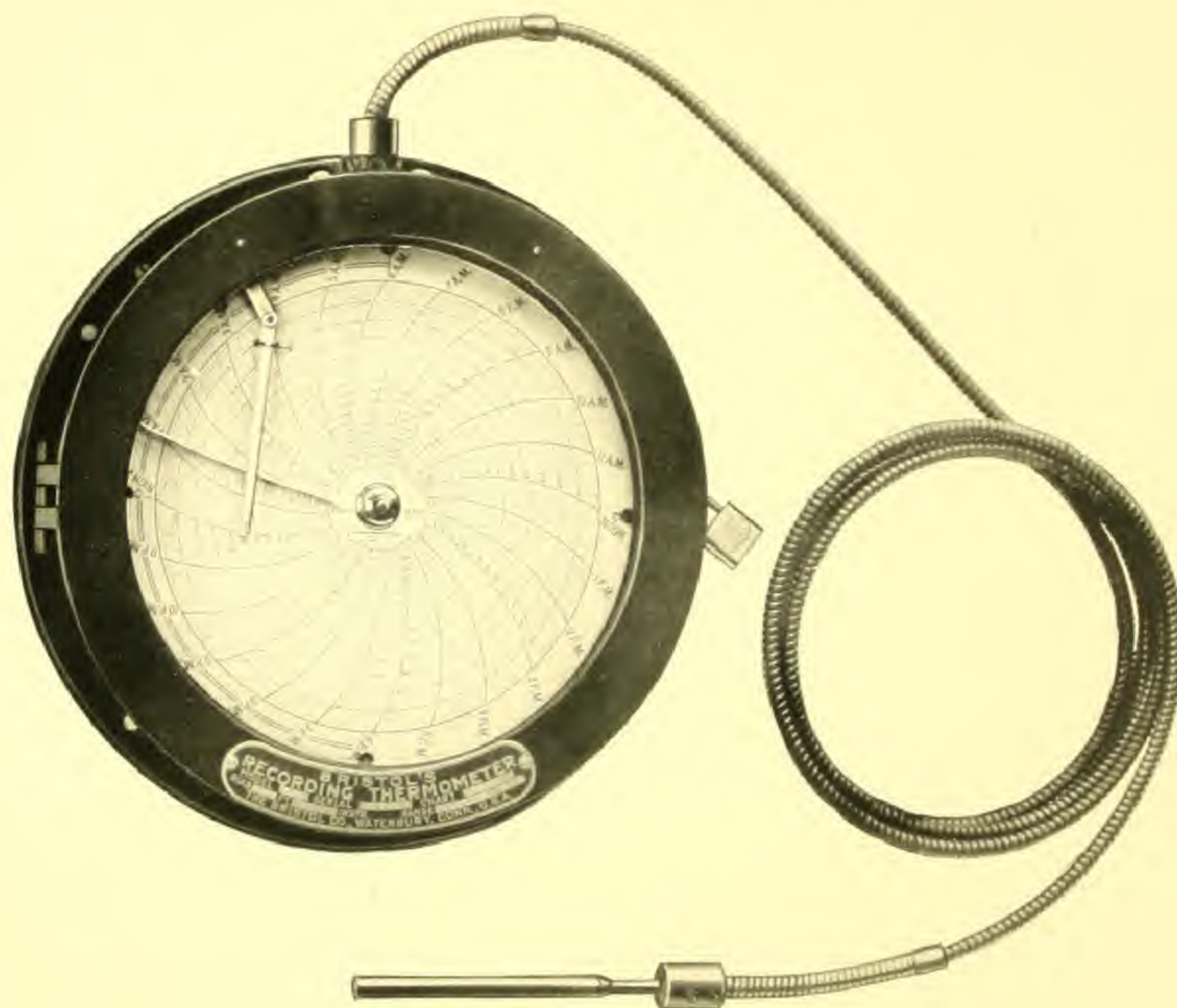


Figure 2005

Instead of the upright penarm used on many of the instruments shown in this catalog—the above is equipped with inverted penarm. This is accomplished by inverting the complete movement. Because of the rugged construction and simple design, the "Inverted Type" from a mechanical standpoint, is not necessary in any Bristol's Recorder. However, any Class II Recording Thermometer can be furnished made up this way, when required.

The illustration shows the instrument top connected, but this is not regular and the standard is front connected as shown on page 8.

Prices for "Inverted Type" are same as those listed for standard instruments.

See Pages 40 and 41 for List Prices.



## AUTOMATIC ELECTRIC ALARM

Used With Bristol's Recording Thermometers

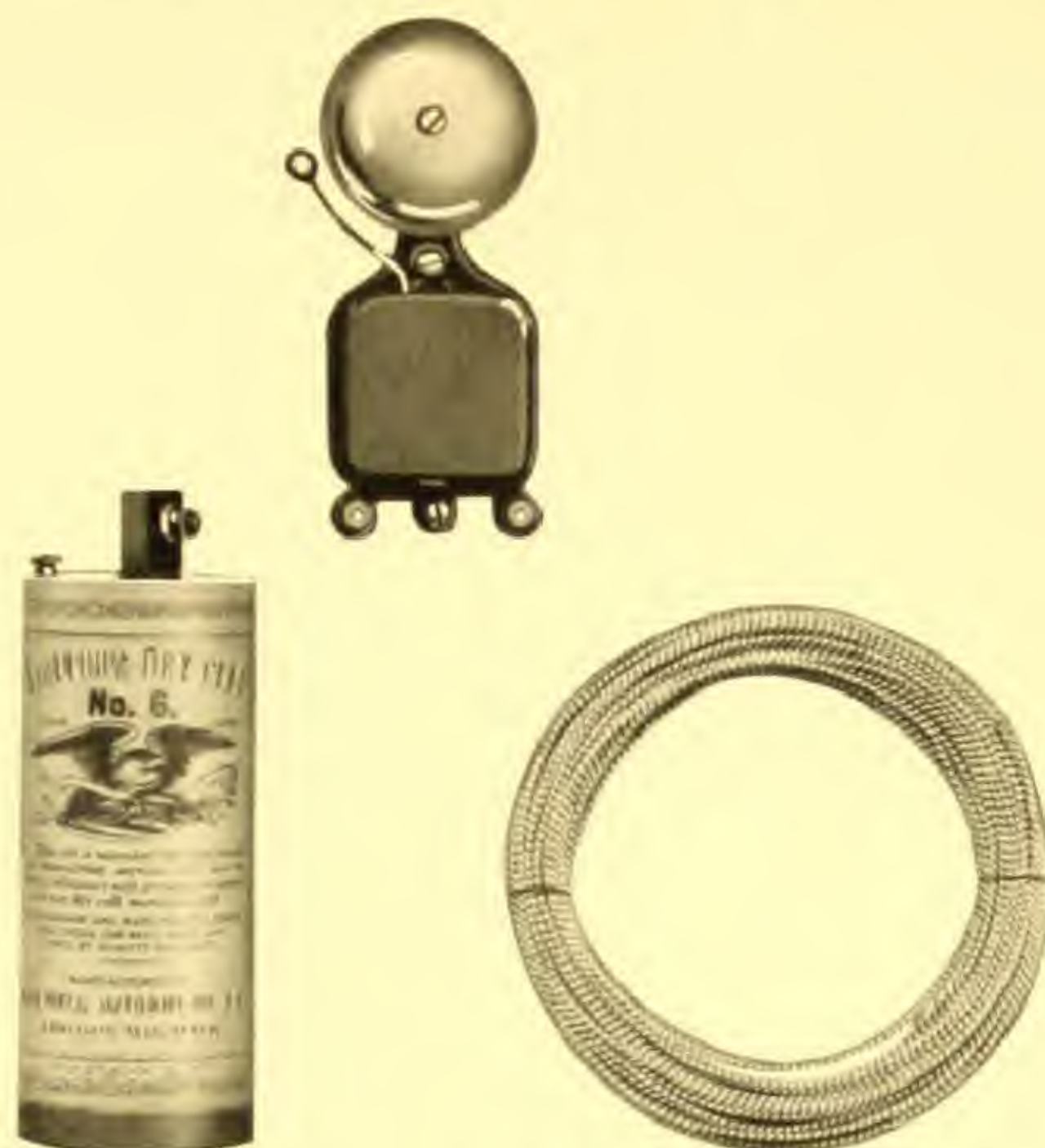


Fig. 1407

Alarm Bell, to warn of too high or too low temperatures can be furnished to automatically operate from Bristol's Recording Thermometers. Such an alarm is used to inform the operator of the approaching danger point, and is often a very important addition to the regular service rendered by the recording instrument.

Only the external parts of the electric alarm are shown here—including bell, dry battery and bell wire. The equipment inside the instrument consists of a contact device installed back of the dial, so arranged to make contact at two points (high and low) on the scale. These contact points are adjustable and can be changed as desired, within the scale range, to suit individual requirements. The only exception to using this is with Round Form Model 61, which case does not provide sufficient room for adjustable contact; but permanent contact can be used with this model.

The bell is connected to the recorder by ordinary bell wire and is operated by current from Dry Cell Battery. Contacts can also be furnished to operate from lighting circuit 110 volt A. C. or D. C. and when necessary 220 volts. When used with D. C. a special bell is required for which an additional charge is made. With A. C. a transformer must be used and can also be furnished if desired.

When Automatic Electric Alarm Attachment is required, it should be specified on order with instrument; it cannot be satisfactorily installed outside of the laboratory. Recording Thermometers now in the field should be returned to the factory to be equipped with Electric Alarm Attachment.

AUTOMATIC ELECTRIC ALARM ATTACHMENT complete, including Bell, Dry Cell, 100 feet of Bell Wire, and Adjustable Contact Device, mounted and adjusted to Bristol's Recording Thermometers, List Price.....\$16.50

AUTOMATIC ELECTRIC ALARM ATTACHMENT for use with lighting circuit.  
Prices quoted on request.



## SETH THOMAS CLOCK

Made Especially for Bristol's Recording Instruments

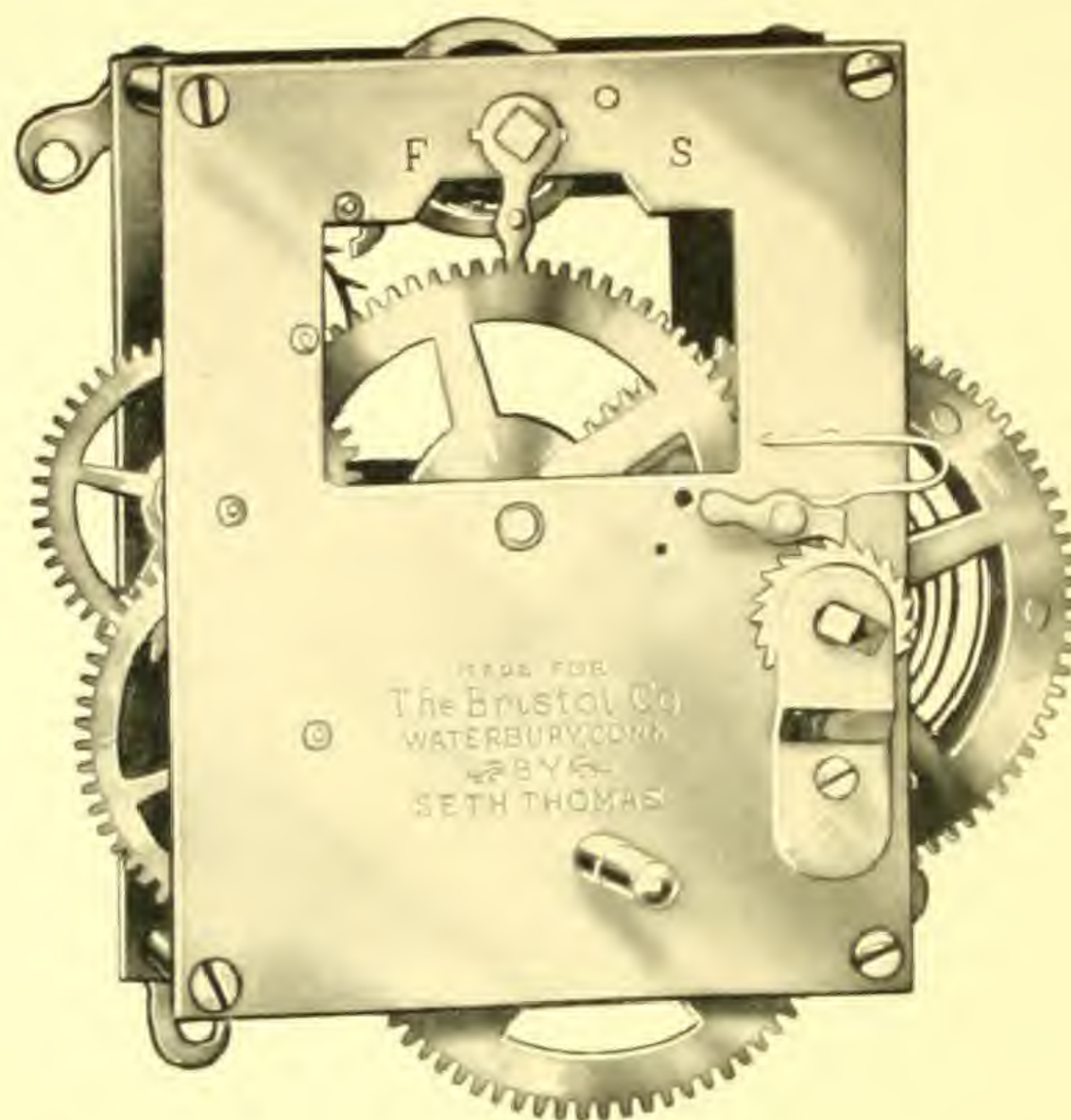


Fig. 1702

To revolve the charts in Bristol's Recording Thermometers a clock movement is employed. The charts are divided into time arcs, thus, it is possible to know the exact time at which certain conditions occur.

The clock used is a specially designed "Seth Thomas" make. The reputation for high-grade workmanship and time-keeping qualities of Seth Thomas Clocks are so well known that further mention is uncalled for.

One complete revolution in twenty-four hours, and seven days, are the two standard clock speeds. For test work faster speeds, 12 hours, 6 hours, 1 hour, etc., are furnished as required. However, one revolution in fifteen minutes is the fastest ever recommended to use.

With charts which are changed daily a clock making one complete revolution in twenty-four hours is used. The standard 24-hour clock requires winding every day; however, a clock with 24-hour speed and arranged to wind every seventh day can be furnished when desired. This is known as the weekly 24-hour clock, and only furnished when specified.

For charts making one continuous record in seven days, a 7-day speed clock is used. The 7-day clock will actually run for eight days with one winding. This gives ample power even on the seventh day, which insures an accurate and complete chart record.



## SOME OF THE REFINEMENTS FURNISHED WITH BRISTOL'S RECORDING THERMOMETERS



Fig. 1939

### Pen Lifter

This device is furnished as standard equipment with all Bristol's Recorders. With it the chart can be changed conveniently without spoiling the record or injuring the pen arm. No extra charge is made for this feature.

### Micrometer Adjustable Pointer

The adjustable pen arm, as shown in Fig. 1939, is also furnished as standard equipment with all Bristol's Recording Thermometers. This simply necessitates turning the small screw to slightly change the adjustment of the Thermometer, if this for any reason is necessary. When preferred the pivoted type of adjustable pen arm, shown in Fig. 1870, can be furnished instead. Either type does not influence the price of the instrument.

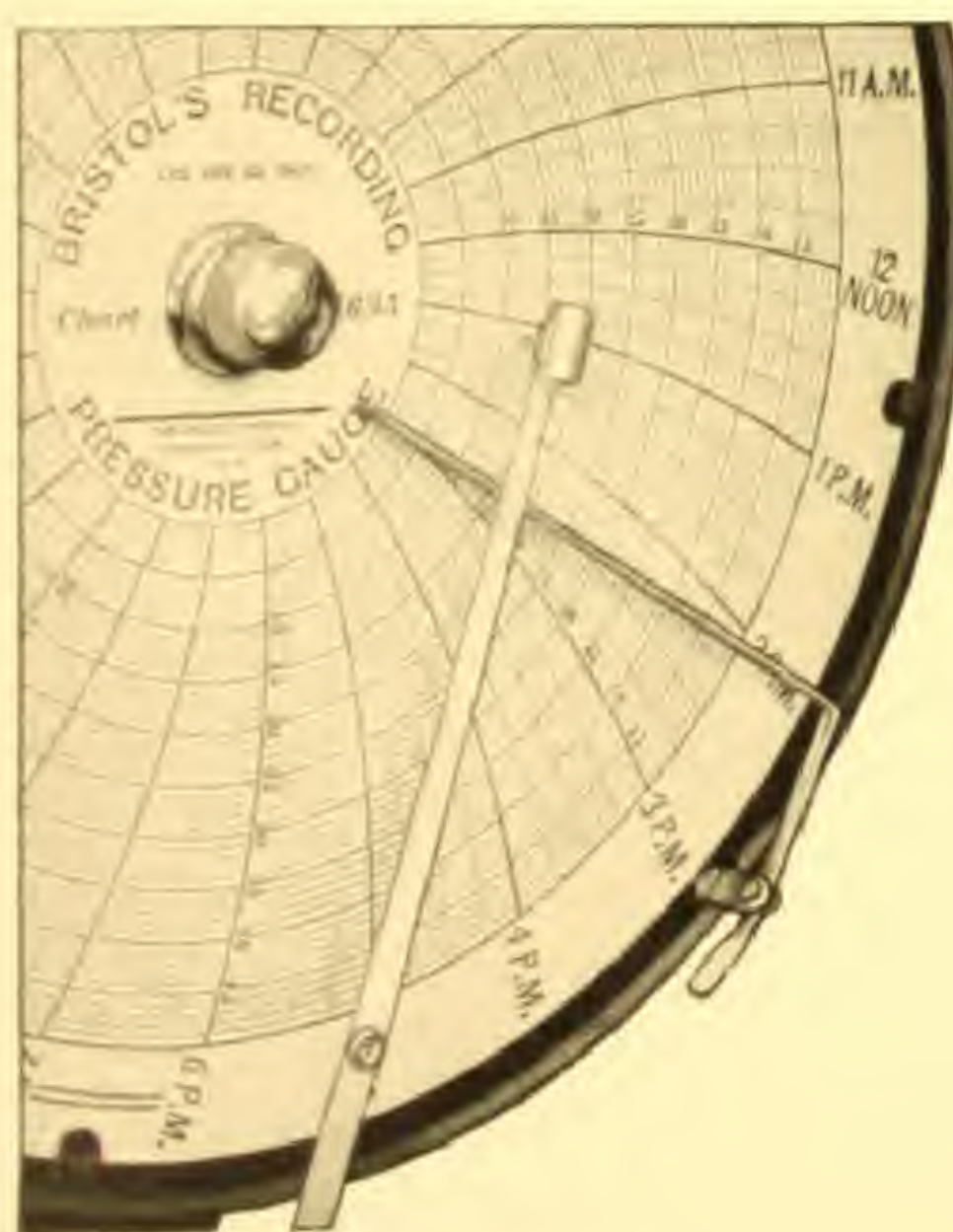
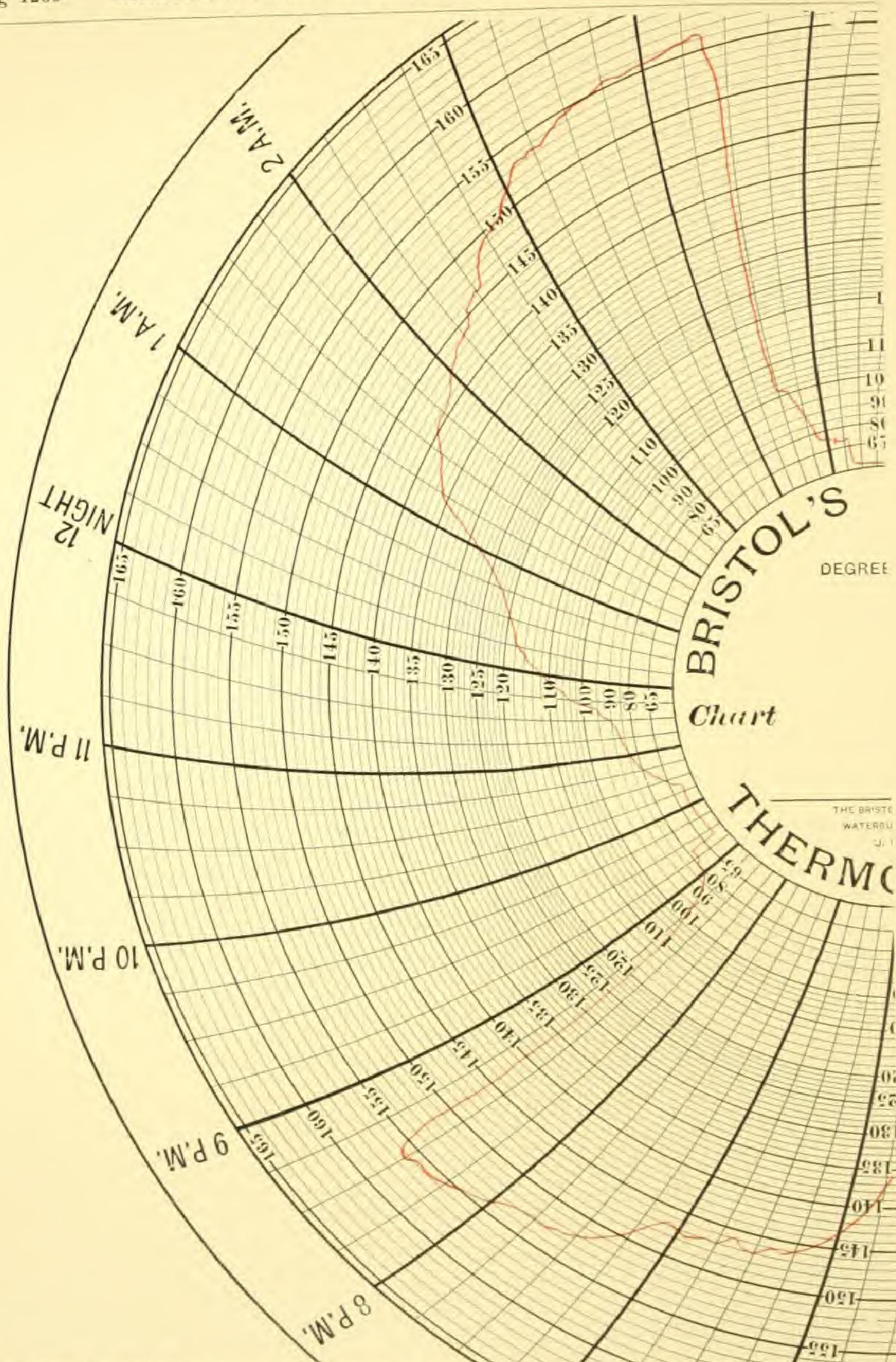


Fig. 1870

### Fountain Pen

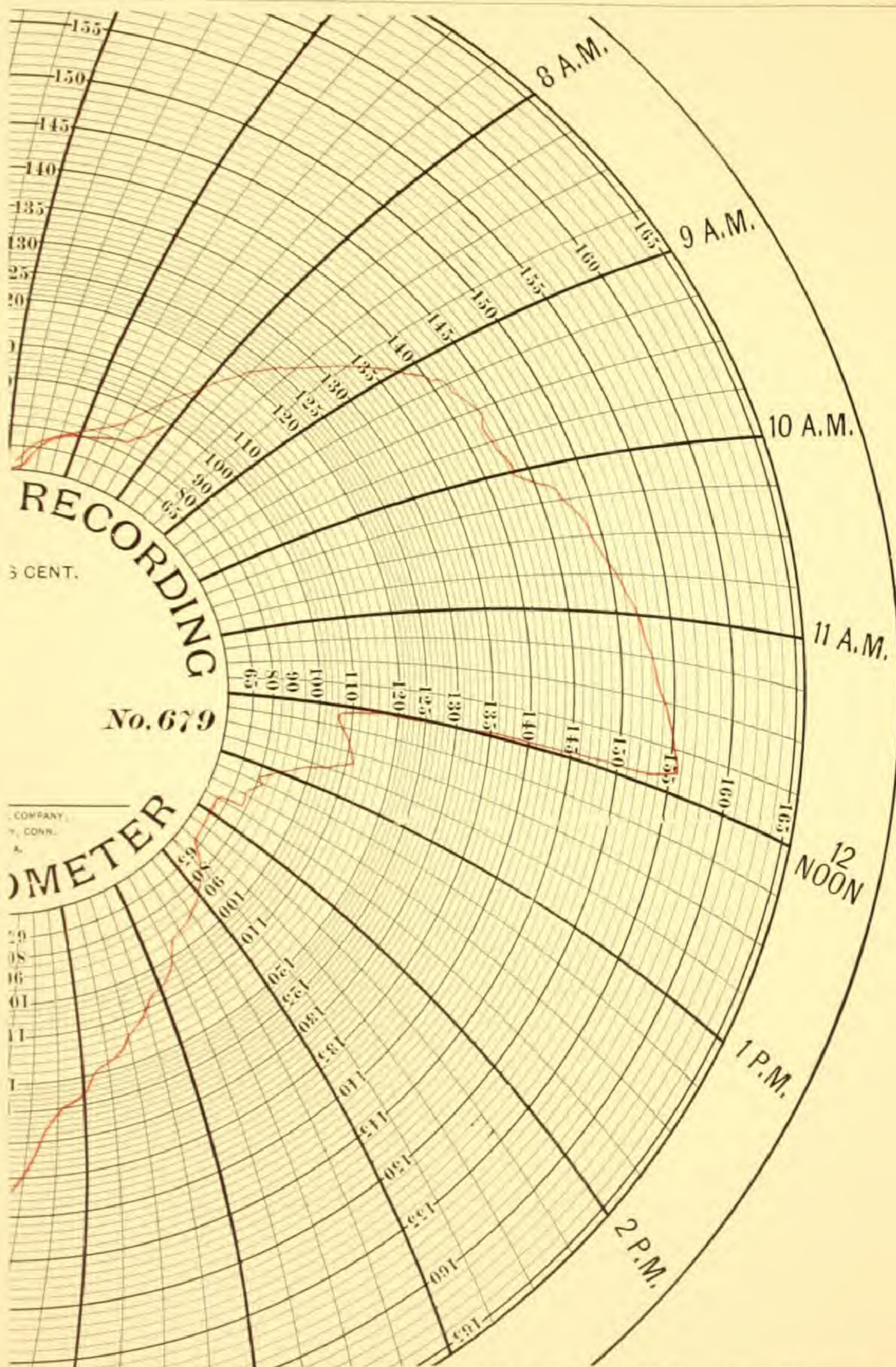
Fig. 1870 illustrates the Fountain Pen furnished with Bristol's Recorders when specified. It is exceptionally useful in connection with applications where it is not possible to as frequently place ink in the pen as required by the V-shaped pen shown in Fig. 1939. The Fountain Pen draws a very fine line and can be attached to any Bristol's Thermometer. Price, 66 cents list.





Full-size Fac-simile Sections of 24-Hour 12-Inch Chart with a Record of Temperature in





Sulphite Pulp Digester as recorded by standard Bristol's Class II Recording Thermometer.

ELECTRICITY

MOTION, ETC.



## 12-INCH CHARTS

### For Use with Models 211, 212 and 240

Chart No.	Working Range	Total Scale	One Rev. of Chart	Specimen Sections of Charts
1934	90 to 150° F	30 to 165° F	24 Hrs.	
1922	90 to 160° F	30 to 175° F	7 Dys.	
676	90 to 160° F	30 to 175° F	24 Hrs.	
1932	90 to 195° F	30 to 212° F	7 Dys.	
657	90 to 195° F	30 to 212° F	24 Hrs.	
1904	100 to 210° F	30 to 230° F	7 Dys.	
629	100 to 210° F	30 to 230° F	24 Hrs.	
696	150 to 255° F	30 to 270° F	24 Hrs.	
1911	150 to 255° F	30 to 270° F	12 Hrs.	
1910	150 to 280° F	30 to 300° F	3 Hrs.	
*1921	210 to 285° F	200 to 300° F	24 Hrs.	
1942	180 to 310° F	30 to 330° F	48 Hrs.	
649	180 to 310° F	30 to 330° F	24 Hrs.	
678	180 to 310° F	30 to 330° F	24 Hrs.	
1929	180 to 310° F	30 to 330° F	12 Hrs.	
1945	200 to 330° F	130 to 350° F	24 Hrs.	
1918	200 to 345° F	30 to 360° F	12 Hrs.	
1912	180 to 380° F	30 to 400° F	24 Hrs.	

\*\$5.50 Extra List

Special Charts Graduated to Order.



## 12-INCH CHARTS

For Use with Models 211, 212 and 240

Chart No.	Working Range	Total Scale	One Rev. of Chart	Specimen Sections of Charts
687 1901	300 to 470° F 300 to 470° F	200 to 500° F 200 to 500° F	24 Hrs. 12 Hrs.	
665 695	30 to 90° C 30 to 90° C	0 to 100° C 0 to 100° C	24 Hrs. 12 Hrs.	
1936	40 to 100° C	0 to 110° C	24 Hrs.	
674 1902	60 to 120° C 60 to 120° C	0 to 130° C 0 to 130° C	7 Dys. 24 Hrs.	
1933	60 to 135° C	25 to 145° C	24 Hrs.	
*1943	80 to 150° C	60 to 160° C	12 Hrs.	
1923 679	80 to 155° C 80 to 155° C	0 to 165° C 0 to 165° C	7 Dys. 24 Hrs.	
*1937	90 to 165° C	50 to 175° C	24 Hrs.	
*1927	100 to 185° C	50 to 195° C	24 Hrs.	
631 635 658	25 to 55° R 25 to 55° R 25 to 55° R	0 to 63° R 0 to 63° R 0 to 63° R	7 Dys. 24 Hrs. 1 Hr.	
615	30 to 80° R	0 to 88° R	7 Dys.	
624 640	30 to 80° R 30 to 80° R	0 to 88° R 0 to 88° R	24 Hrs. 6 Hrs.	
639	50 to 112° R	0 to 120° R	24 Hrs.	

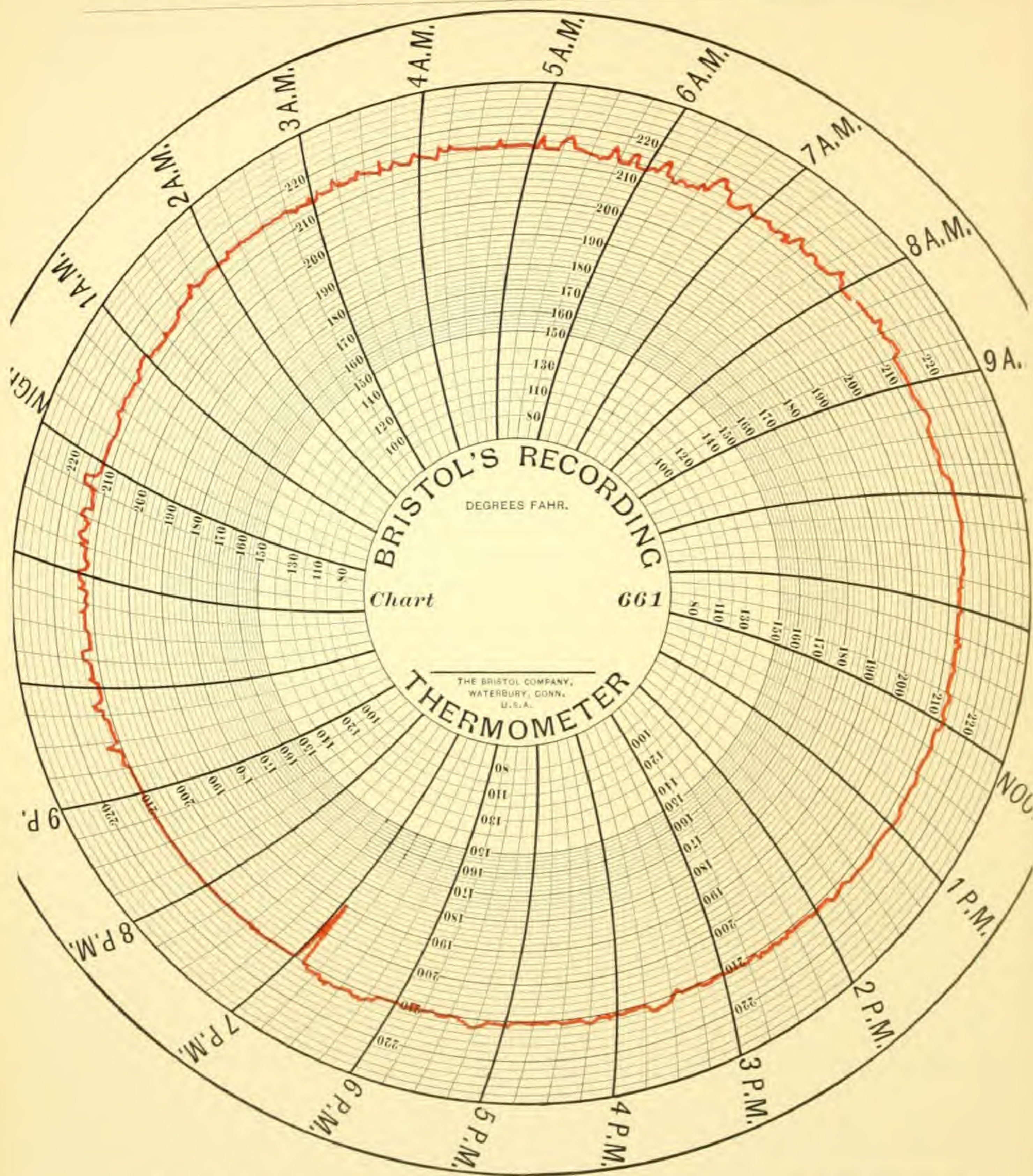
\*\$5.50 Extra List

Special Charts Graduated to Order.

ELECTRICITY

MOTION, ETC.





An eminent Power Plant Engineer who has used many Bristol Recording Instruments sent us the above record from one of his Bristol Feed Water Recording Thermometers and commented as follows:

"We have several of these thermometers in service and have found them remarkably accurate and positive in their indications, recording for months, without adjustment of any kind, the correct temperature within 1 or 2 degrees Fahrenheit. Further when installed beside a mercurial thermometer of standard make, I have found your instrument by far the more sensitive to rapid fluctuations of temperature."



## 8-INCH CHARTS

### For Use with Models 211, 212 and 240

Chart No.	Working Range	Total Scale	One Rev. of Chart	Specimen Sections of Charts
1919 644	90 to 160° F 90 to 160° F	30 to 175° F 30 to 175° F	7 Days 24 Hours	
1931	90 to 170° F	90 to 180° F	24 Hours	
1944	90 to 190° F	30 to 200° F	24 Hours	
1917	100 to 190° F	90 to 200° F	7 Days	
685	110 to 185° F	100 to 200° F	24 Hours	
*1913 *1920 *1924	120 to 210° F 120 to 210° F 120 to 210° F	120 to 220° F 120 to 220° F 120 to 220° F	24 Hours 12 Hours 6 Hours	
*1930	120 to 210° F	120 to 220° F (Reversed)	12 Hours	
637 661 1909	100 to 210° F 100 to 210° F 100 to 210° F	30 to 230° F 30 to 230° F 30 to 230° F	7 Days 24 Hours 12 Hours	
623	150 to 250° F	30 to 270° F	7 Days	
662 656	150 to 250° F 150 to 250° F	30 to 270° F 30 to 270° F	24 Hours 1 Hour	
668	150 to 260° F	30 to 280° F	24 Hours	
663 634 686 1928	180 to 280° F 180 to 280° F 180 to 280° F 180 to 280° F	30 to 300° F 30 to 300° F 30 to 300° F 30 to 300° F	24 Hours 12 Hours 8 Hours 3 Hours	
*1916 *1925 *1926	200 to 300° F 200 to 300° F 200 to 300° F	200 to 320° F 200 to 320° F 200 to 320° F	24 Hours 12 Hours 3 Hours	
664	180 to 310° F	30 to 330° F	24 Hours	
675	200 to 330° F	30 to 350° F	24 Hours	
670 646	250 to 375° F 250 to 375° F	30 to 400° F 30 to 400° F	7 Days 24 Hours	
1914	250 to 375° F	30 to 400° F	24 Hours	

\*\$5.50 Extra List

Special Charts Engraved to Order.

ELECTRICITY

MOTION, ETC.



## 8-INCH CHARTS

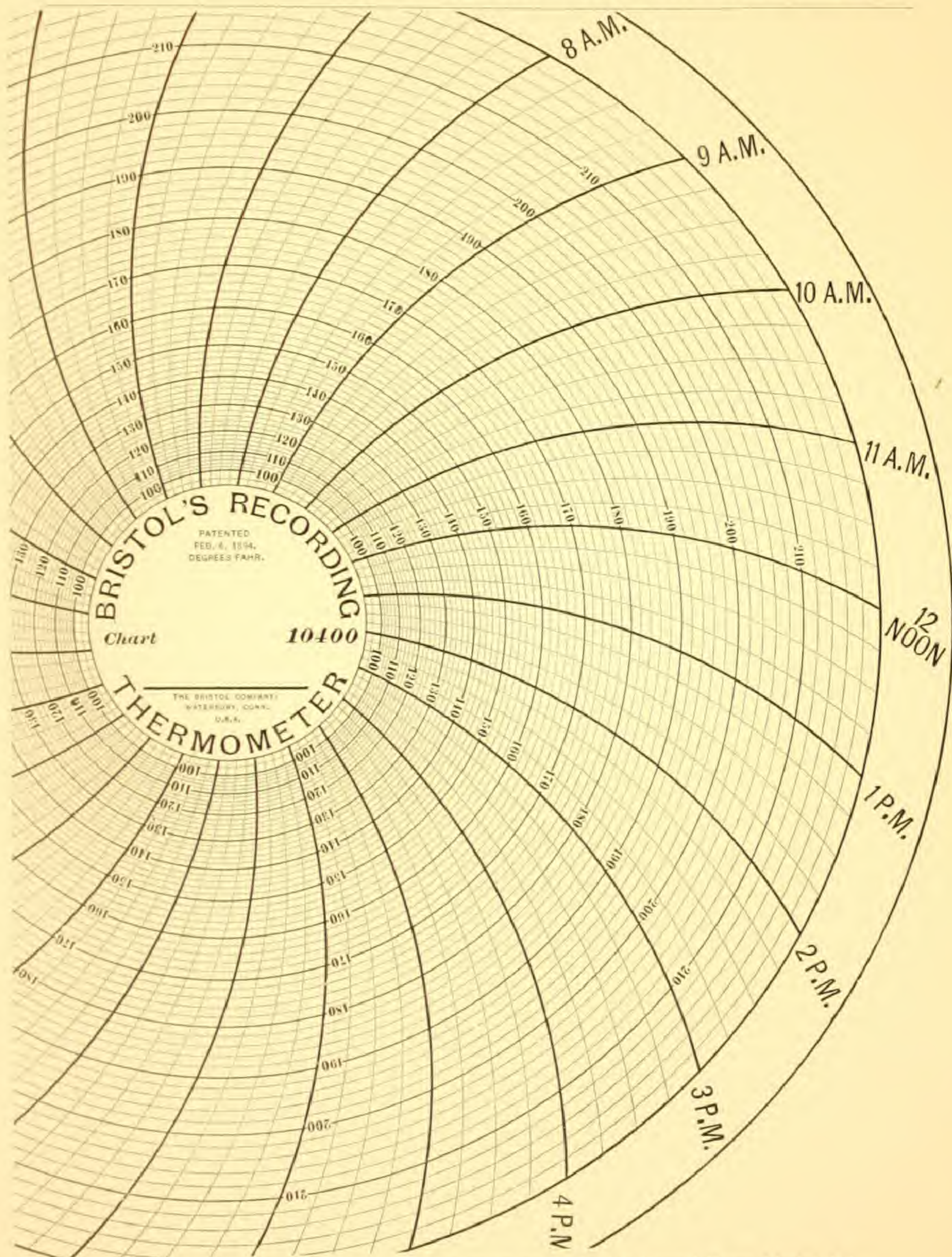
For Use with Models 211, 212 and 240

Chart No.	Working Range	Total Scale	One Revolution of Chart	Specimen Sections of Charts
636	250 to 380° F	30 to 415° F	24 Hours	
671	300 to 470° F	30 to 500° F	7 Days	
605	300 to 470° F	30 to 500° F	24 Hours	
643	30 to 45° C	0 to 50° C	24 Hours	
1905	30 to 50° C	0 to 55° C	7 Days	
*1903	30 to 65° C	20 to 71° C	7 Days	
669	30 to 70° C	0 to 79° C	24 Hours	
1908	30 to 70° C	0 to 80° C	24 Hours	
683	30 to 86° C	0 to 100° C	7 Days	
632	30 to 86° C	0 to 100° C	24 Hours	
1906	40 to 100° C	0 to 110° C	7 Days	
1907	40 to 100° C	0 to 110° C	24 Hours	
1939	70 to 125° C	0 to 132° C	24 Hours	
630	60 to 140° C	0 to 150° C	24 Hours	
667	80 to 155° C	0 to 165° C	24 Hours	
641	90 to 170° C	0 to 185° C	24 Hours	
1900	90 to 170° C	0 to 185° C	1 Hour	
1960	100 to 185° C	0 to 200° C	7 Days	
677	100 to 185° C	0 to 200° C	24 Hours	
692	25 to 55° R	0 to 63° R	24 Hours	
614	30 to 80° R	0 to 88° R	24 Hours	

\*\$5.50 Extra List

Special Charts Graduated to Order.



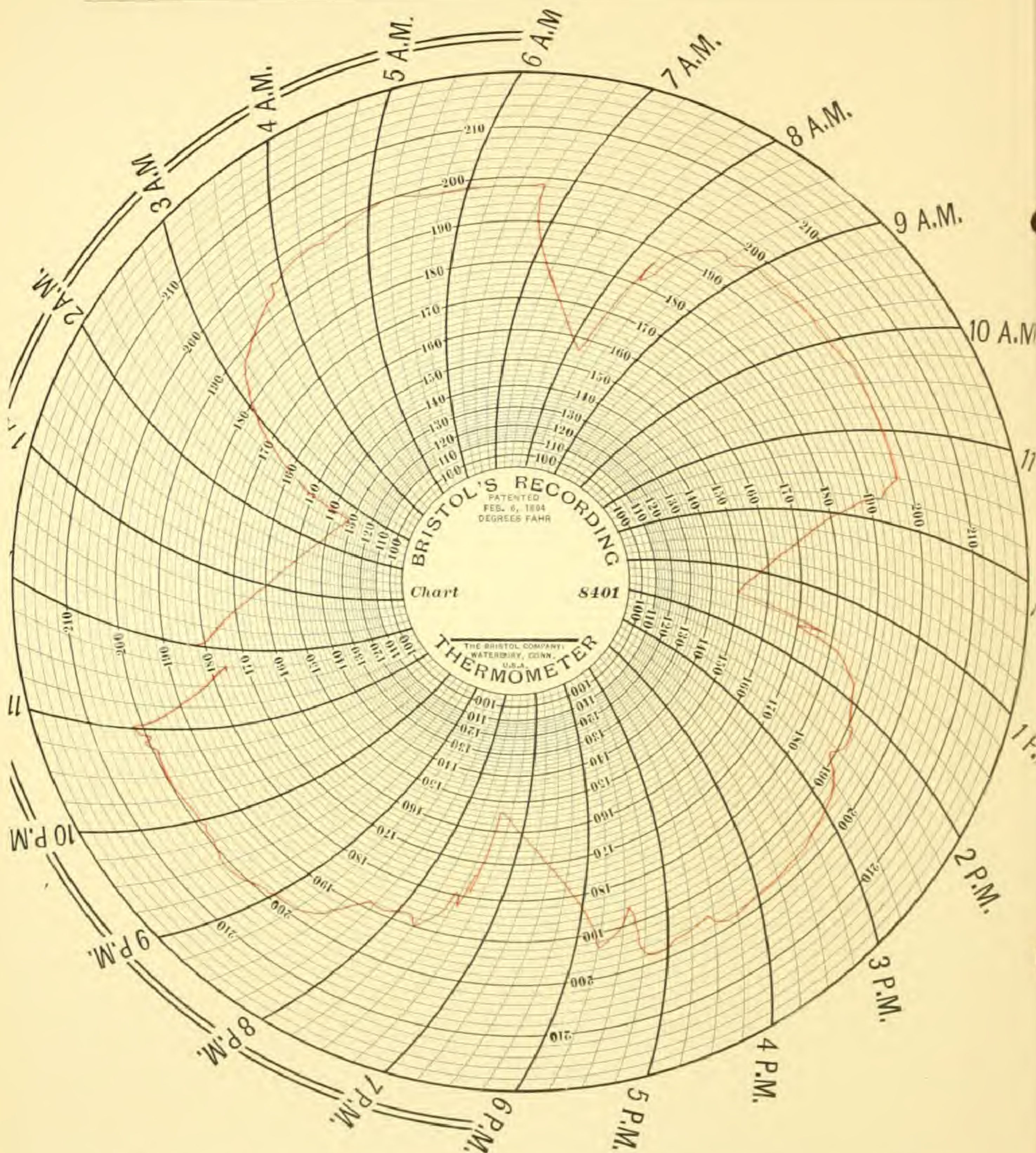


Fac-simile specimen section of 10-inch chart as used with Round Form Model 261.

ELECTRICITY

MOTION, ETC.





The above is full size fac-simile of 8-inch chart, with record from a Bristol's Class II Round Form Recording Thermometer, Model 261. The record is of Boiler Feed Water Temperature and shows when the engine is started and stopped. In reference to the instruments the users write: "We must say that these instruments are giving good results and working very satisfactorily."



## 10-INCH AND 8-INCH CHARTS

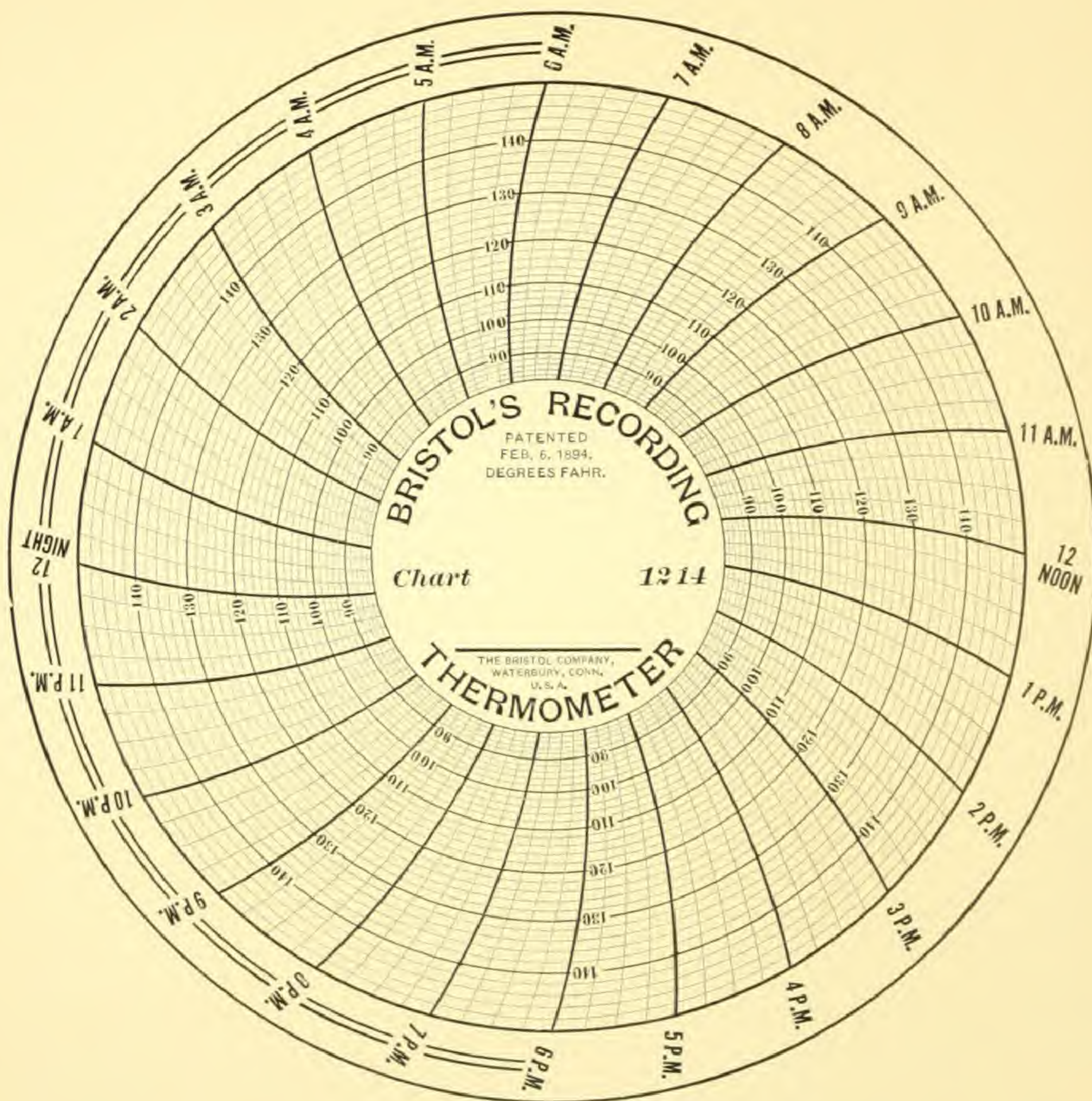
For Use with Model 261

Chart No.	Size of Chart Inches	Range	One Rev. of Chart	Specimen Sections of Charts
10400	10	90 to 220° F	24 Hrs.	
10403	10	90 to 250° F	24 Hrs.	
10401	10	90 to 330° F	24 Hrs.	
10404	10	90 to 400° F	24 Hrs.	
10402	10	20 to 80° C	24 Hrs.	
8400	8	32 to 176° F	24 Hrs.	
8410	8	80 to 180° F	24 Hrs.	
8402	8	80 to 180° F	6 Hrs.	
8401	8	90 to 220° F	24 Hrs.	
8403	8	90 to 220° F	12 Hrs.	
8405	8	90 to 250° F	24 Hrs.	
8404	8	90 to 270° F	7 Dys.	
8406	8	90 to 330° F	24 Hrs.	

ELECTRICITY

MOTION, ETC.





### Full Size Reproduction of Chart as Used with Model 247

The range of this particular chart is 80° to 150° Fahrenheit, with scale graduation of 2 degrees and for one revolution in 24-hours.



## 6-INCH CHARTS

### For Use with Model 247

Chart No.	Each Graduation	Working Range	Total Scale	One Revolution of Chart	Specimen Sections of Charts
1214	2° throughout	90 to 140° F	80 to 150° F	24 Hours	
1211	2° throughout	100 to 150° F	90 to 160° F	7 Days	
1203	2° above 100° F	100 to 170° F	90 to 180° F	24 Hours	
1202	2° above 130° F	90 to 186° F	30 to 200° F	24 Hours	
1207	2° above 120° F	100 to 186° F	100 to 200° F	7 Days	
1204	2° above 120° F	100 to 186° F	100 to 200° F	24 Hours	
1205	2° above 150° F	100 to 210° F	30 to 230° F	7 Days	
1200	2° above 150° F	100 to 210° F	30 to 230° F	24 Hours	
1213	5° throughout	125 to 225° F	100 to 240° F	7 Days	
1208	5° above 150° F	100 to 230° F	30 to 250° F	24 Hours	
1216	5° above 150° F	150 to 250° F	100 to 260° F	24 Hours	
1210	2° above 200° F	150 to 260° F	100 to 275° F	24 Hours	
*1212	2° above 230° F	200 to 290° F	180 to 300° F	24 Hours	
1201	2° above 280° F	200 to 320° F	30 to 350° F	24 Hours	
1218	5° above 275° F	250 to 375° F	100 to 400° F	7 Days	
*1215	5° above 300° F	300 to 425° F	250 to 450° F	24 Hours	
1217	2° above 30° C	30 to 90° C	0 to 100° C	7 Days	
1209	2° above 30° C	30 to 90° C	0 to 100° C	24 Hours	
*1206	2° above 66° C	65 to 110° C	65 to 120° C	24 Hours	

\*\$5.50 Extra List

ELECTRICITY

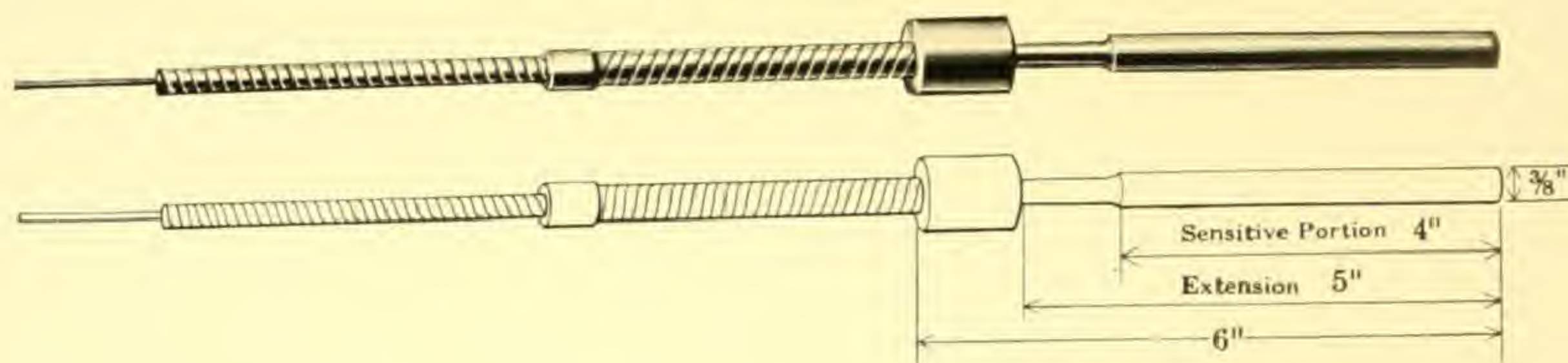
MOTION, ETC.



## PLAIN BULBS

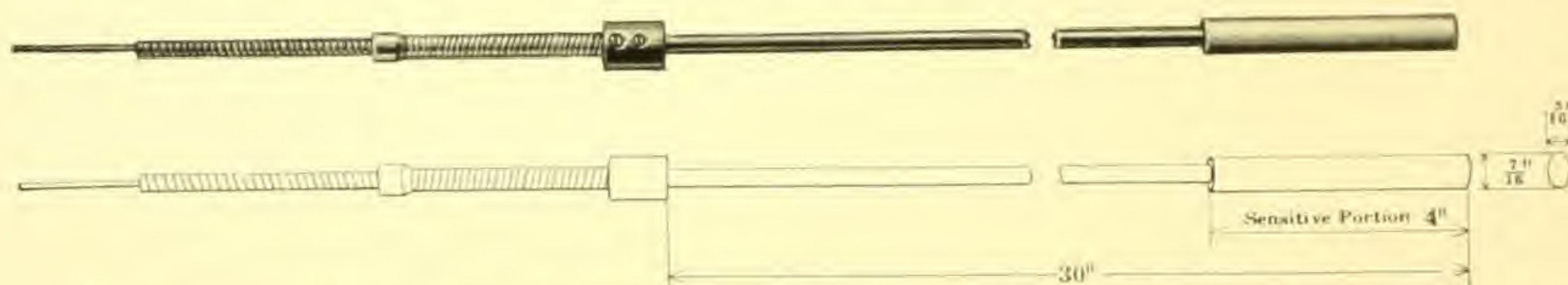
For Use with Class II Recording Thermometers

### Bulb No. 202



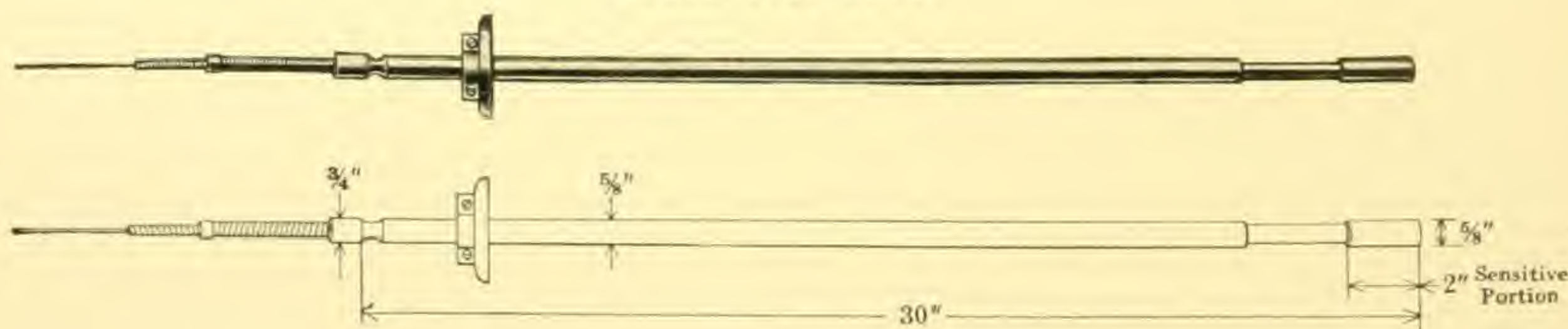
Plain copper bulb; Reinforced Flexible Bronze-Armored Connecting Tube. Used for atmospheric temperatures in open spaces or for suspending in liquids.

### Bulb No. 4202



Plain copper bulb, with extra long extension; Reinforced Flexible Bronze-Armored Connecting Tube. May be furnished with Adjustable Flange, if required. Used for atmospheric temperatures in open spaces or for suspending in liquids.

### Bulb No. 6202



Extra long plain copper bulb; with adjustable flange; Reinforced Flexible Bronze-Armored Connecting Tube. Used for suspending in tanks containing liquids.

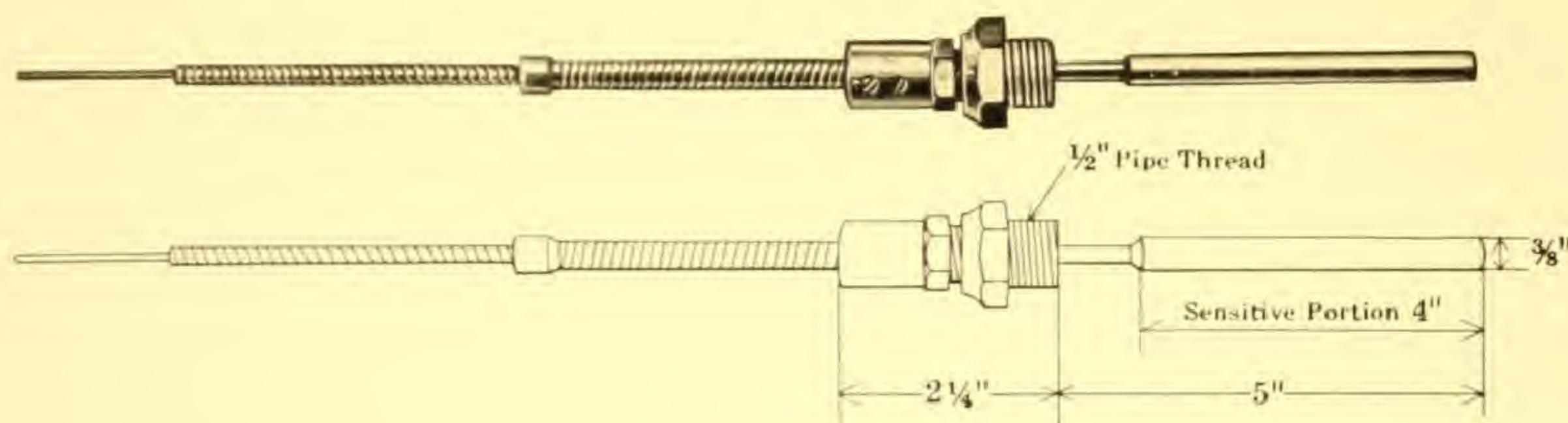
See Pages 40 and 41 for List Prices.



## BULBS WITH UNION CONNECTION

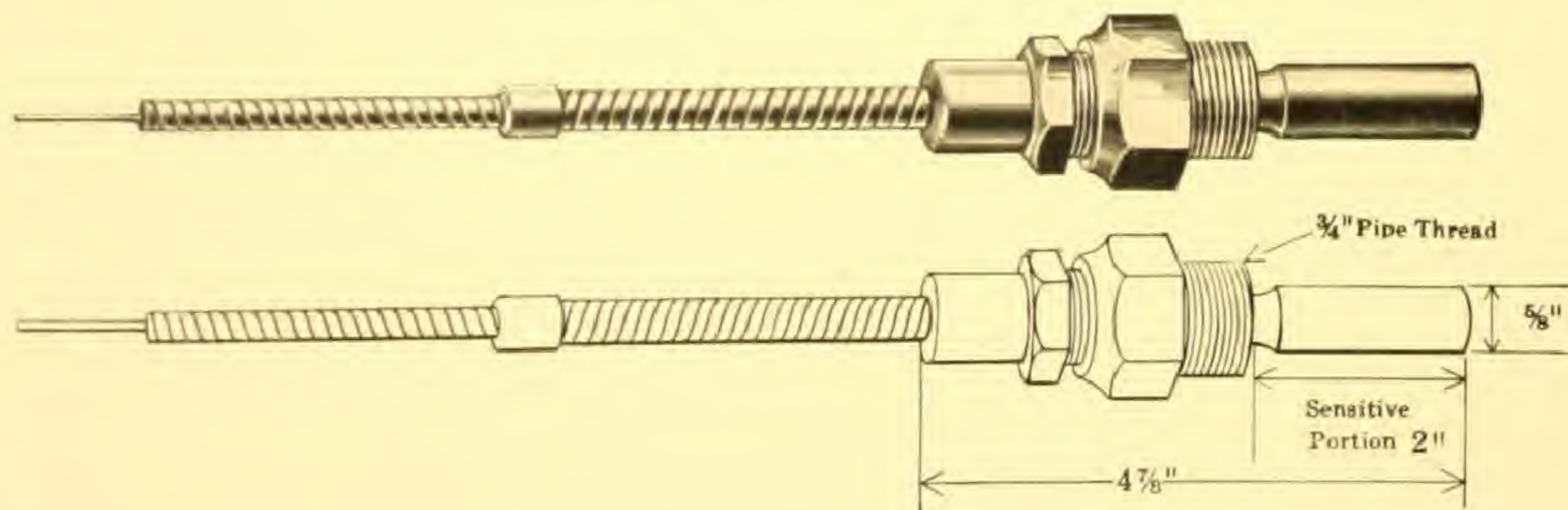
For Use with Class II Recording Thermometers

Bulb No. 222



Copper bulb with Union Connection; Reinforced Bronze-Armored Connecting Tube. Used for temperatures in closed spaces under pressure. See page 35 for method of installing.

Bulb No. 282



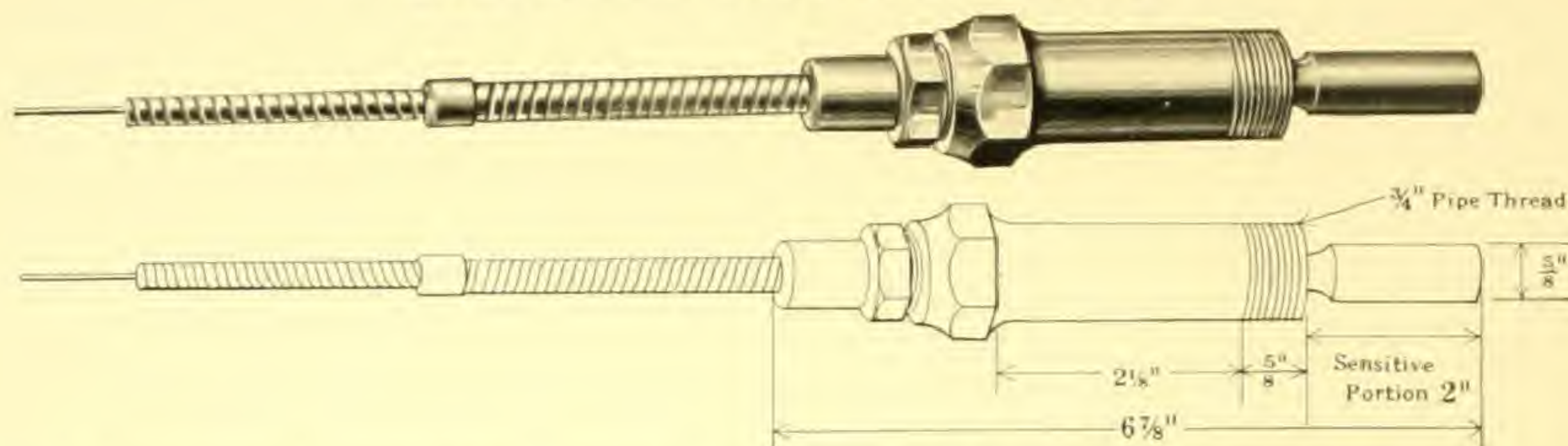
Short brass bulb with Union Connection; Reinforced Flexible Bronze-Armored Connecting Tube. Used for temperatures in closed spaces under pressure.

See Pages 40 and 41 for List Prices.

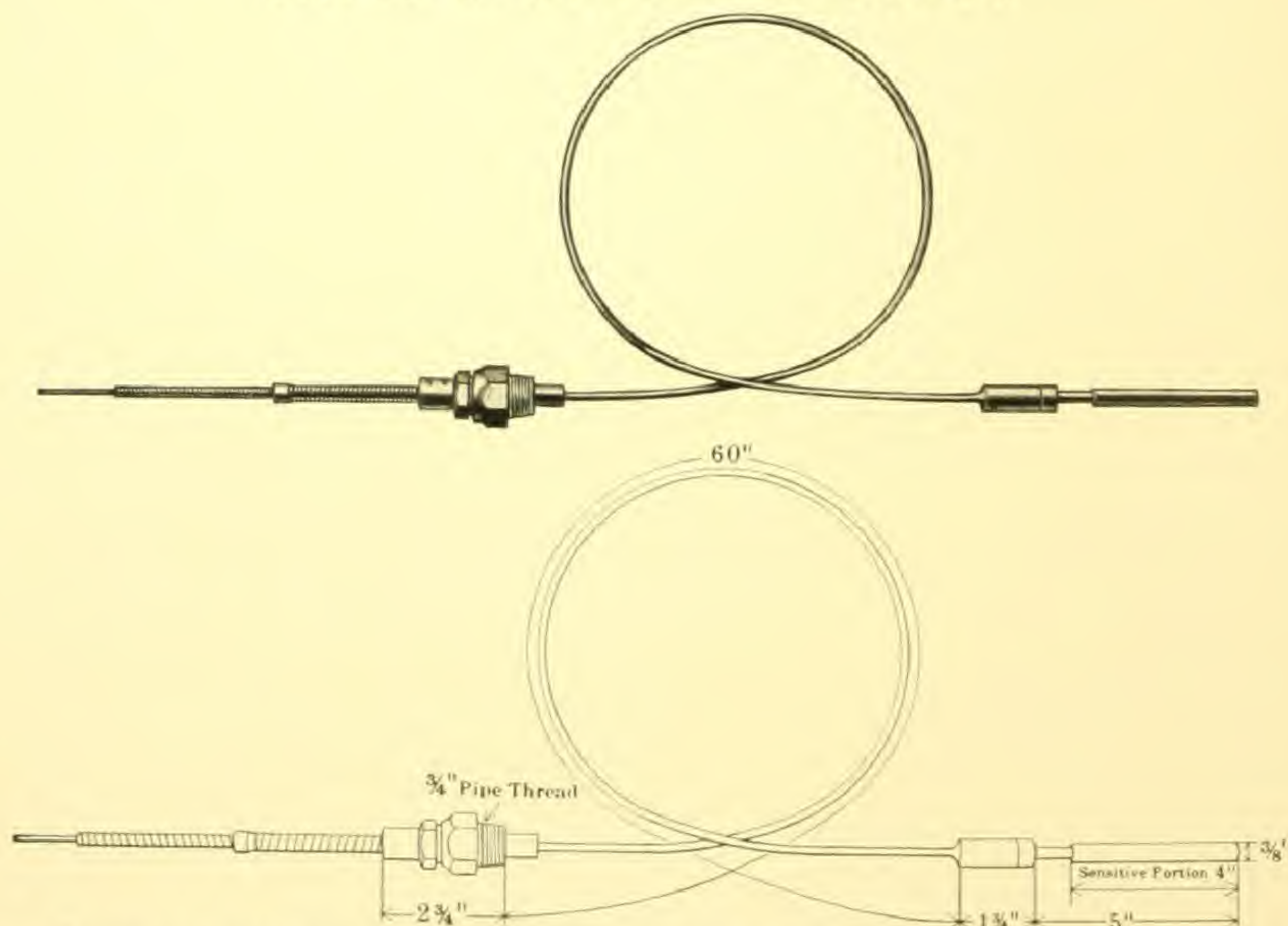


**BULBS WITH UNION CONNECTION**

For Use with Class II Recording Thermometers

**Bulb No. 292 (With Lagging Plug)**

Brass bulb with Union Connection and Extension for Lagging; Reinforced Flexible Bronze-Armored Connecting Tube. Used for temperatures in closed spaces under pressure.

**Bulb No. 207 (With Bendable Extension)**

Copper bulb with Union Connection and extra long Bendable Extension; Reinforced Flexible Bronze-Armored Connecting Tube. Used for temperatures in Vacuum Apparatus, Transformers, etc.

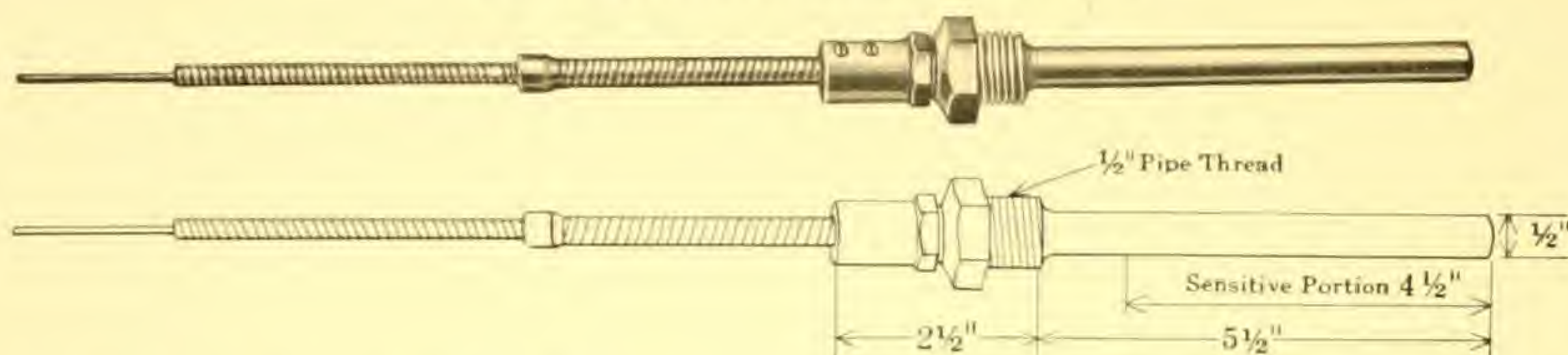
See Pages 40 and 41 for List Prices.



## BULBS WITH UNION CONNECTION AND SEPARABLE SOCKET

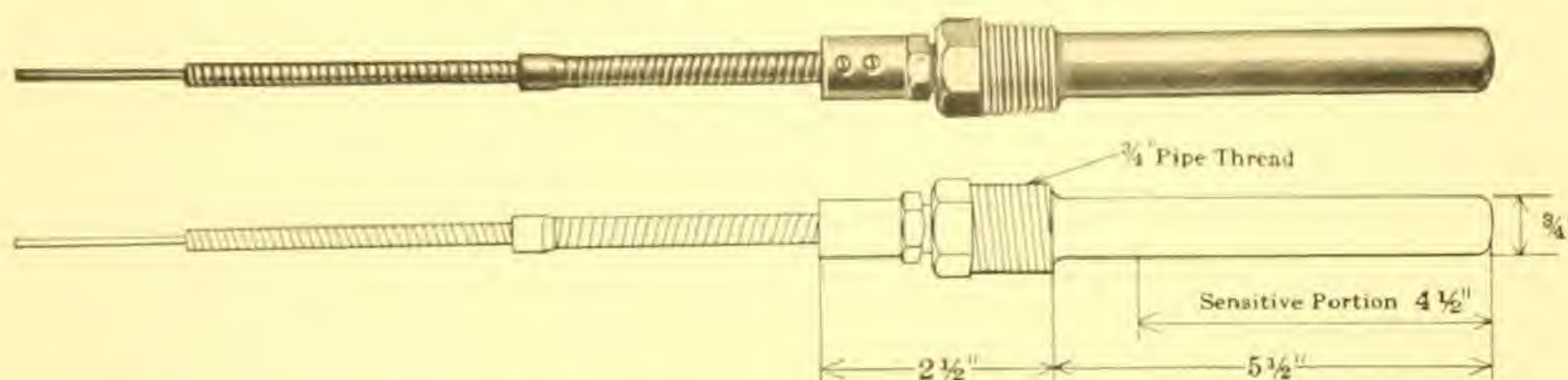
For Use with Class II Recording Thermometers

### BULB No. 232 (Bronze Socket)



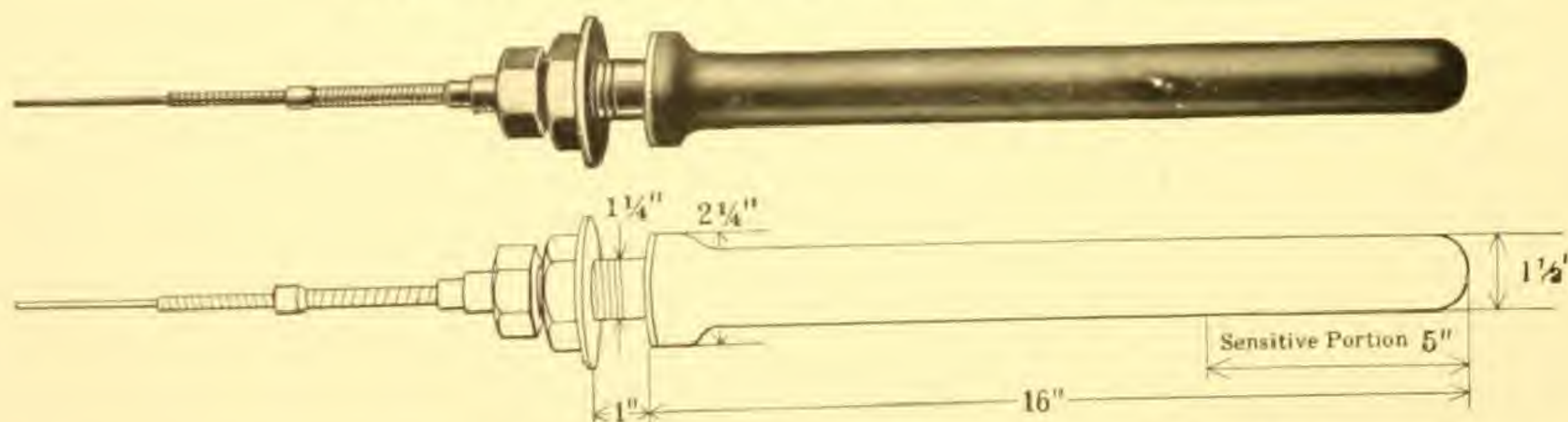
Copper bulb with Union Connection and Separable Bronze Socket; Reinforced Flexible Bronze-Armored Connecting Tube. Used for temperatures in closed spaces under pressure.

### Bulb No. 1242 (Cast-Iron Socket)



Copper bulb with Union Connection and Separable Cast Iron Socket; Reinforced Flexible Bronze-Armored Connecting Tube. Used for temperatures in closed spaces under pressure.

### Bulb No. 2232 (Phosphor-Bronze Socket)



Copper bulb with Separable Phosphor-Bronze Socket; Reinforced Flexible Bronze-Armored Connecting Tube. Specially adapted for Sulphite Digester.

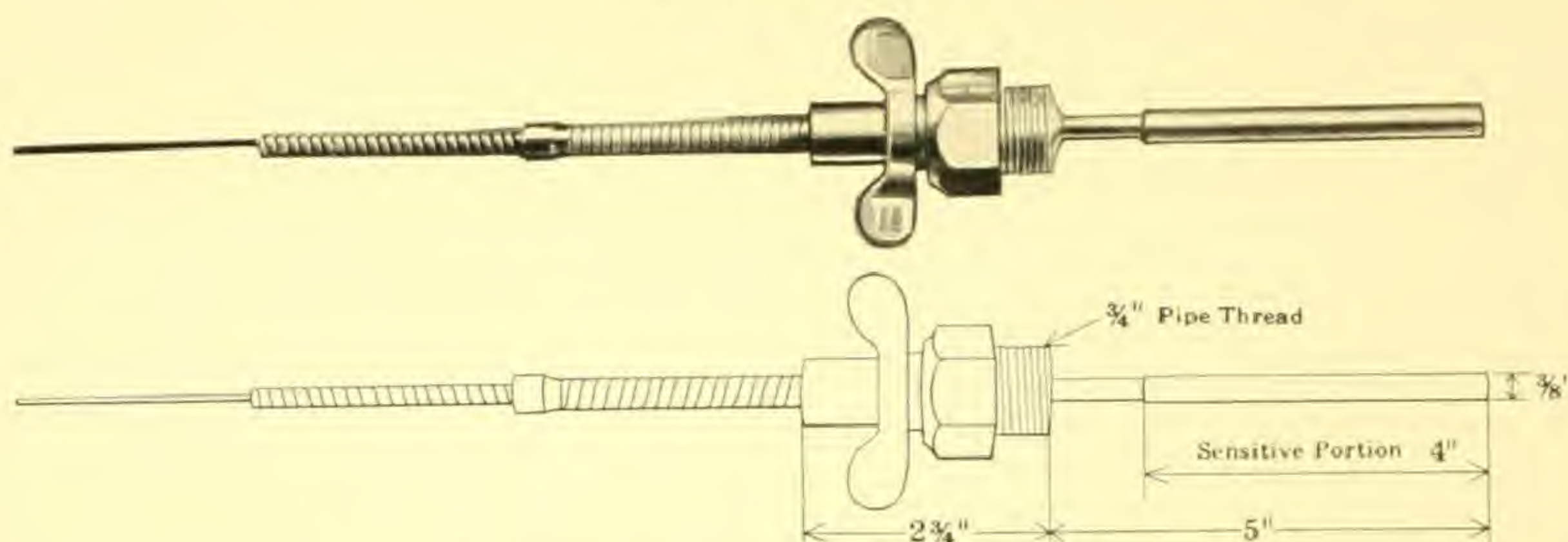
See Pages 40 and 41 for List Prices.



## BULBS WITH UNION CONNECTION AND WING NUT

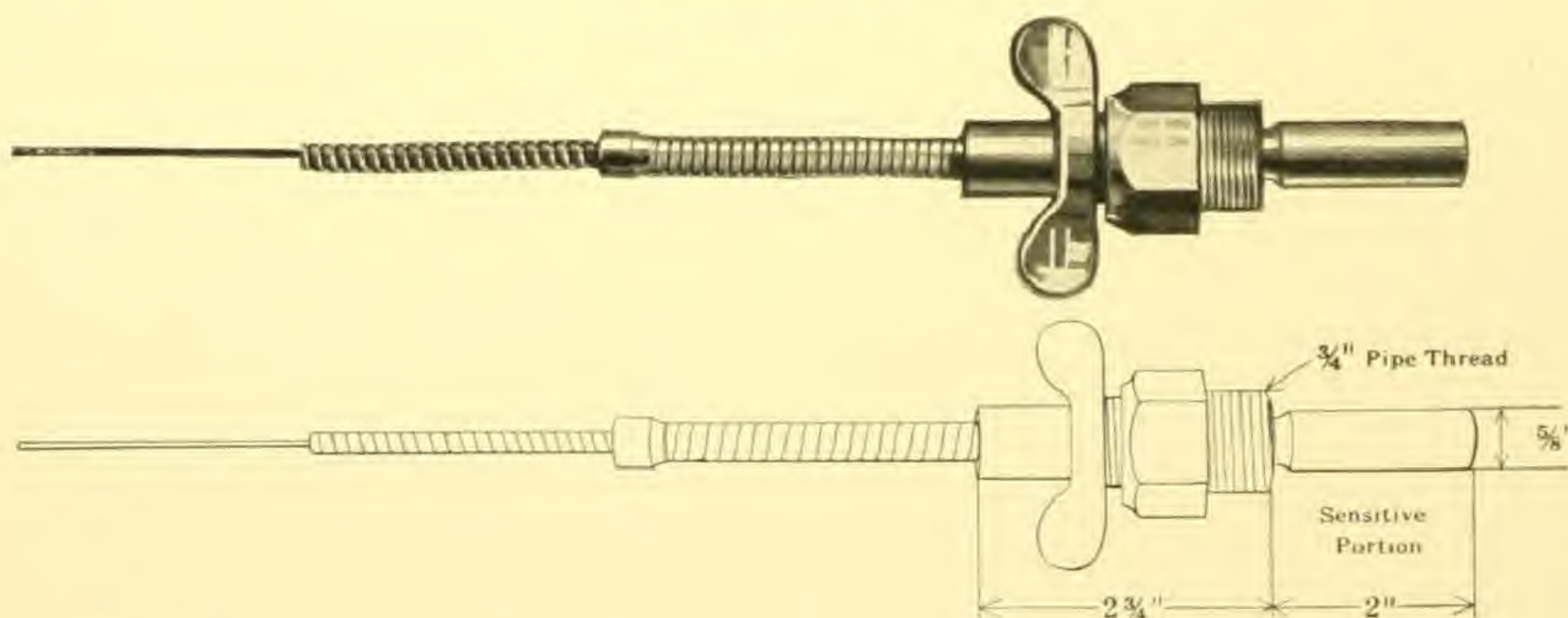
For Use with Class II Recording Thermometers

Bulb No. 4222



Copper bulb with Union Connection and Wing Nut; Reinforced Flexible Bronze-Armored Connecting Tube. Used where it is required to readily detach bulb, as on Vats, Tanks, Pasteurizers, etc.

Bulb No. 1282



Short Brass bulb with Union Connection and Wing Nut; Reinforced Flexible Bronze-Armored Connecting Tube. Particularly adapted for Pasteurizers, and similar applications.

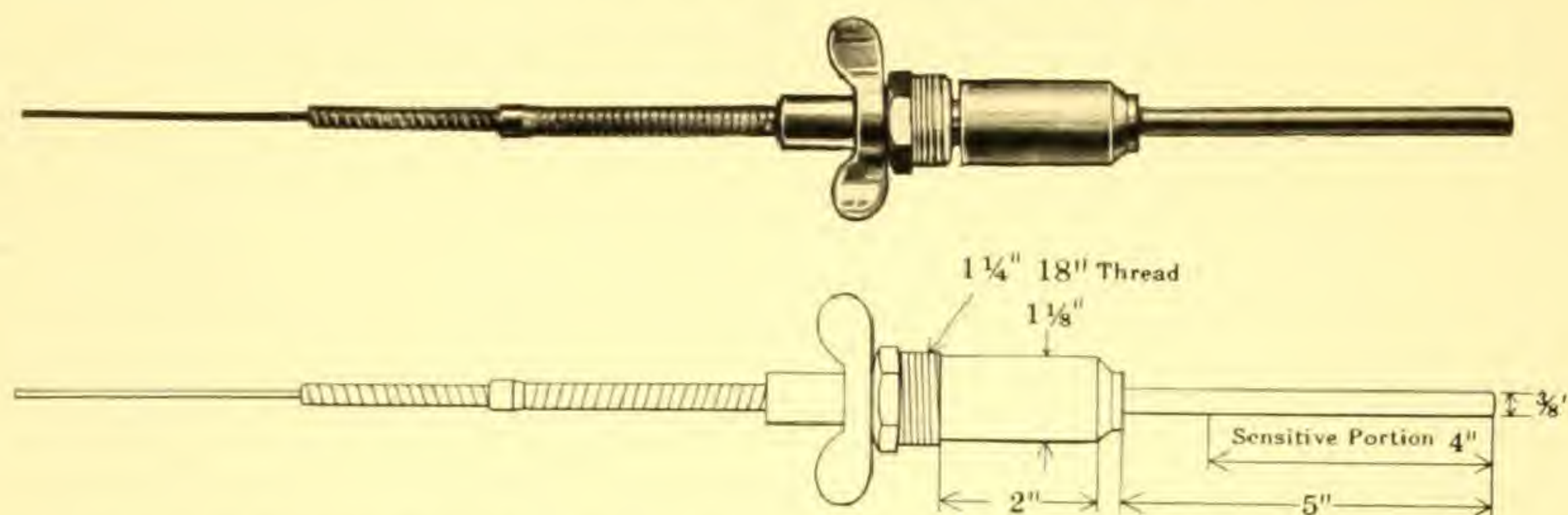
See Pages 40 and 41 for List Prices.



## BULBS WITH UNION CONNECTION AND WING NUT

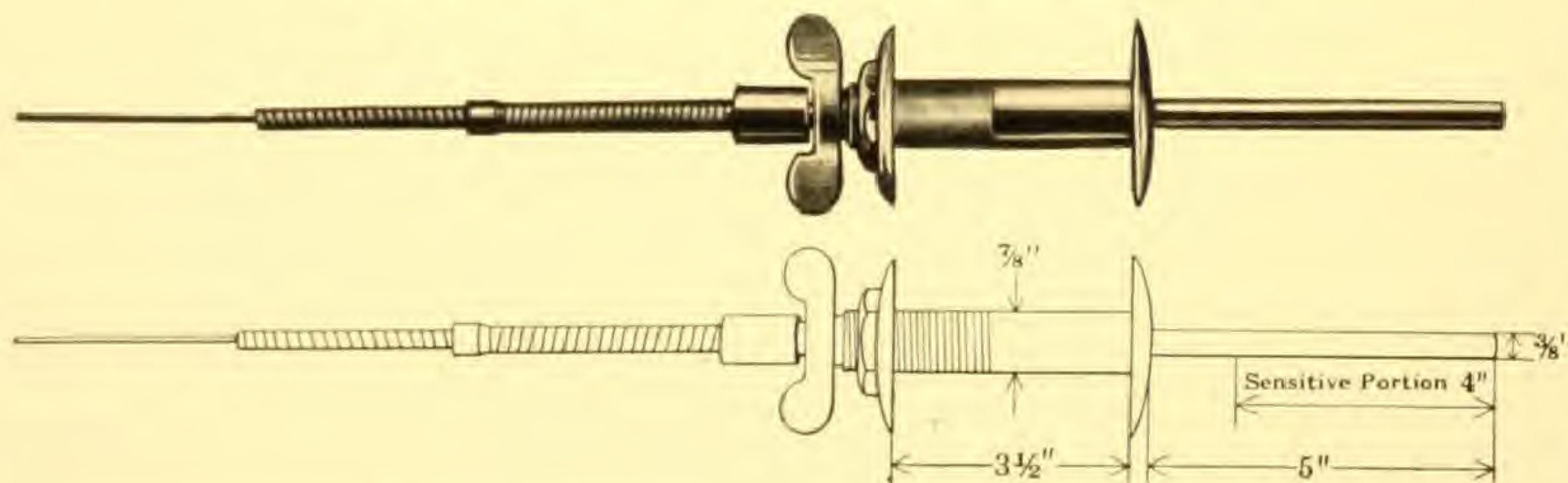
For Use with Class II Recording Thermometers

### Bulb No. 7292 (With Lagging Plug)



Copper bulb with Wing Nut, Union Connection and Lagging Extension; Reinforced Flexible Bronze-Armored Connecting Tube. Used in connection with Pasteurizers.

### Bulb No. 4292 (With Sleeve for Lagging)



Copper screw bulb with Adjustable Sleeve and Wing Nut; Reinforced Flexible Bronze-Armored Connecting Tube. Used on Tanks, Pasteurizers, etc.

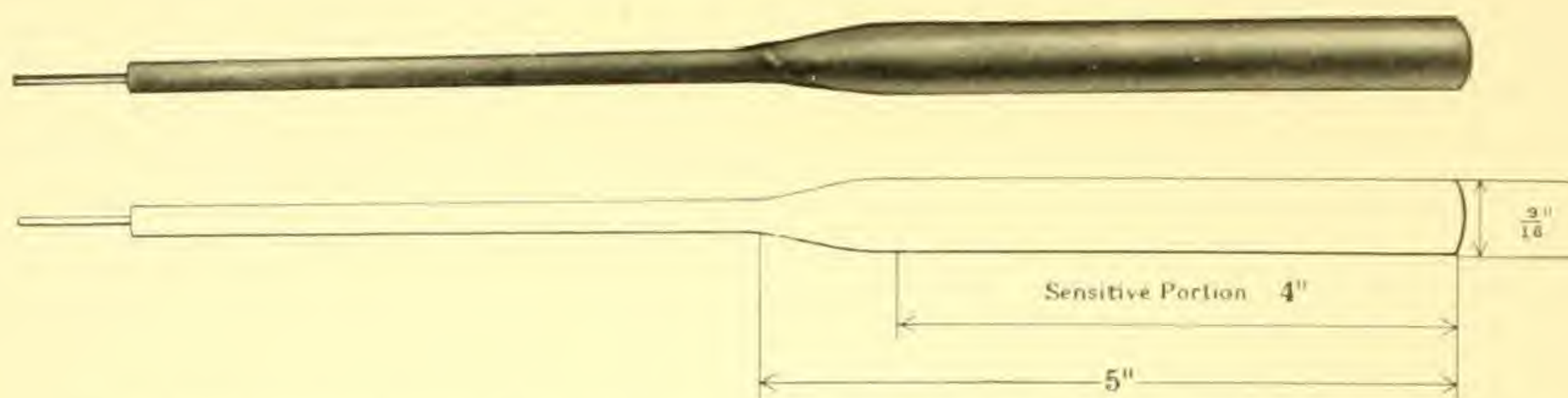
See Pages 40 and 41 for List Prices.



## LEAD COVERED BULBS

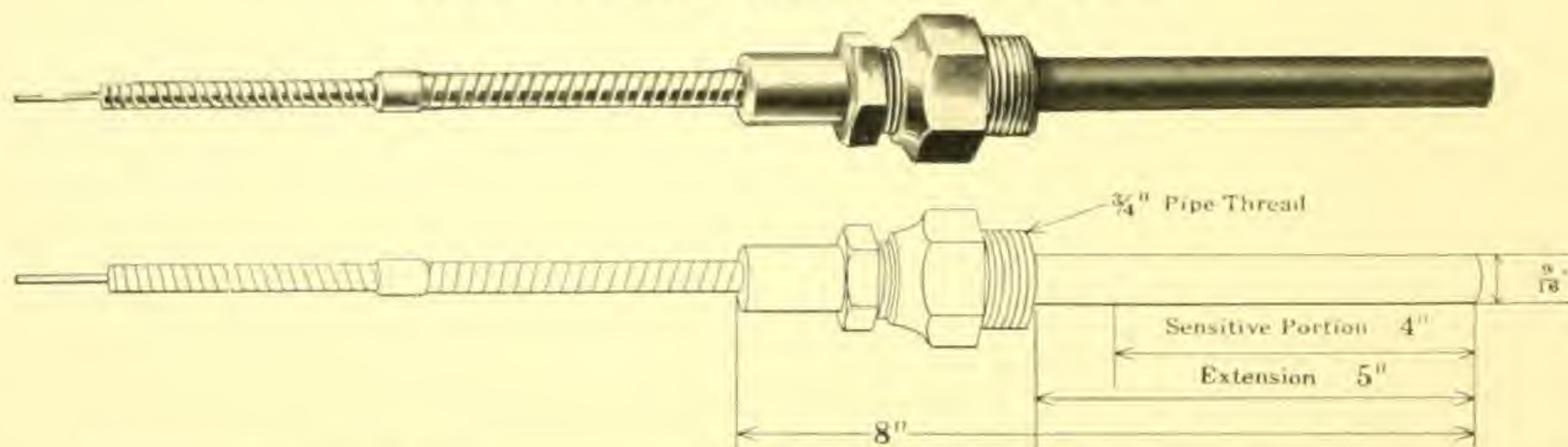
For Use with Class II Recording Thermometers

### Bulb No. 204 (Plain)



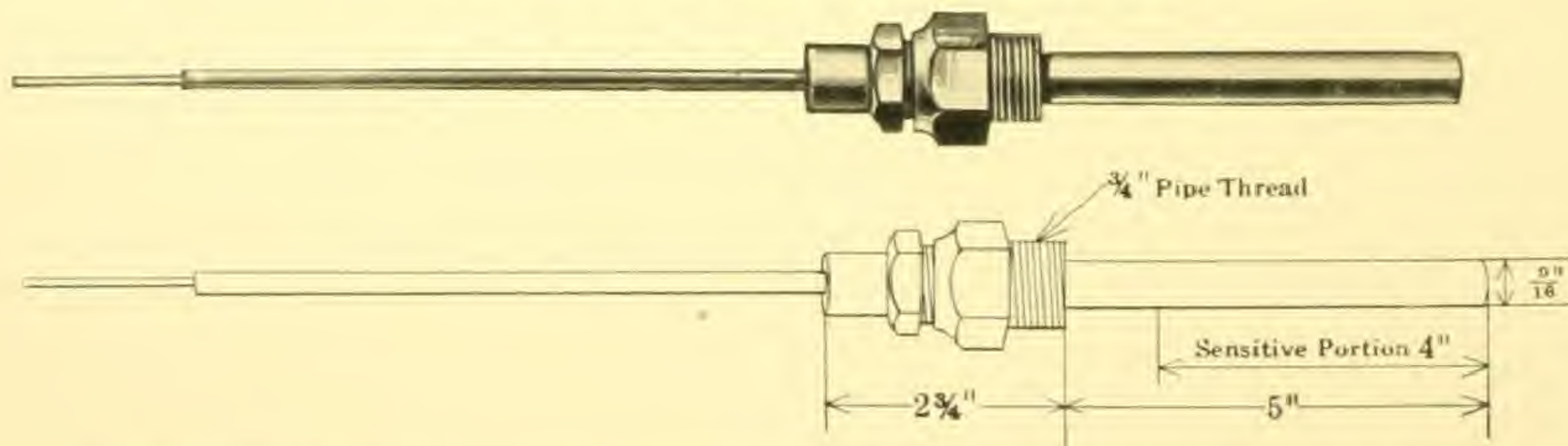
Plain lead-covered bulb; Flexible Lead-Covered Connecting Tube. Used for temperatures in Dry Heaters, etc.

### Bulb No. 252 (Union Connection)



Lead-covered bulb with Union Connection; Reinforced Flexible Bronze-Armored Connecting Tube. Used in Vulcanizers, etc.

### Bulb No. 253 (Union Connection)



Lead-covered bulb with Union Connection; Flexible Lead-Covered Connecting Tube. Used for temperatures in Vulcanizers, etc.

See Pages 40 and 41 for List Prices.



## METHODS OF INSTALLING BULBS

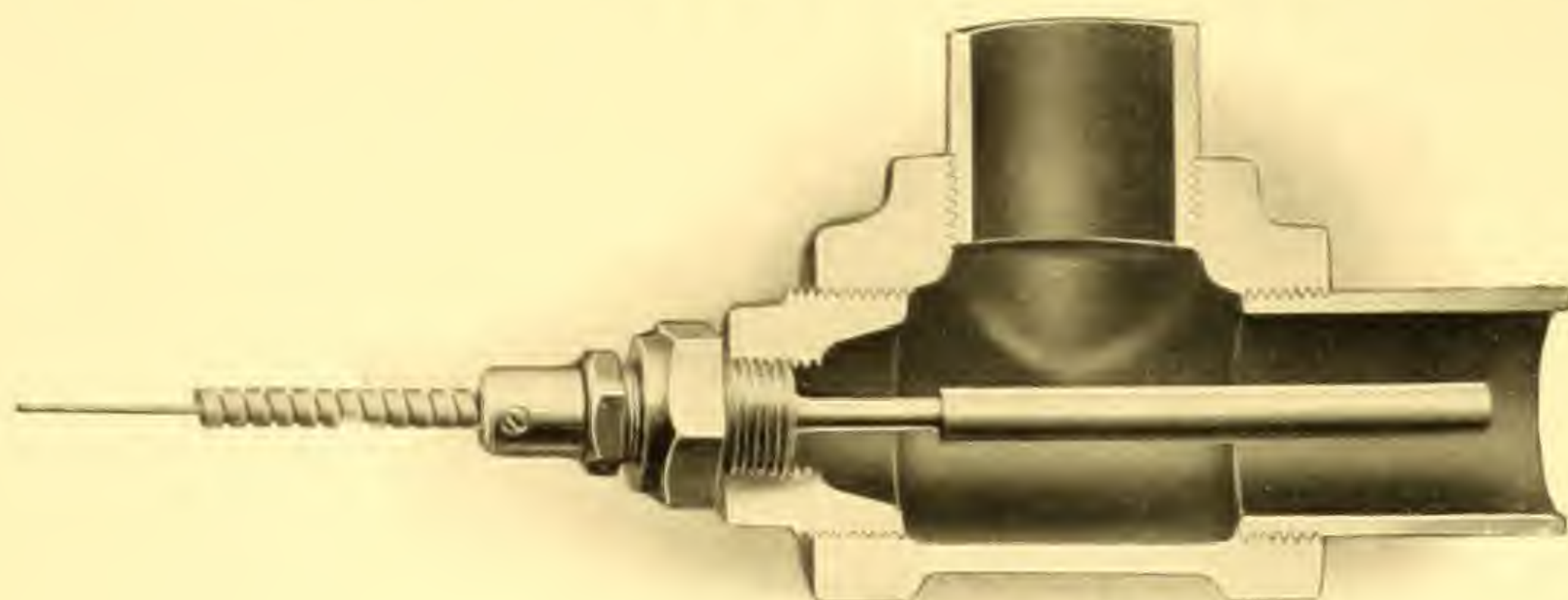


Fig. 549

### Bulbs Installed Under Pressure

The above illustration shows Bulb No. 222 installed at an elbow in the pipe line. This is one of the most satisfactory methods of applying where it is desired to measure temperatures under pressure. Bulbs with separable socket, like No. 232, may also be used in this same way. However, the separable socket remains permanently in place, while the bulb itself may be removed as desired without shutting off the system.

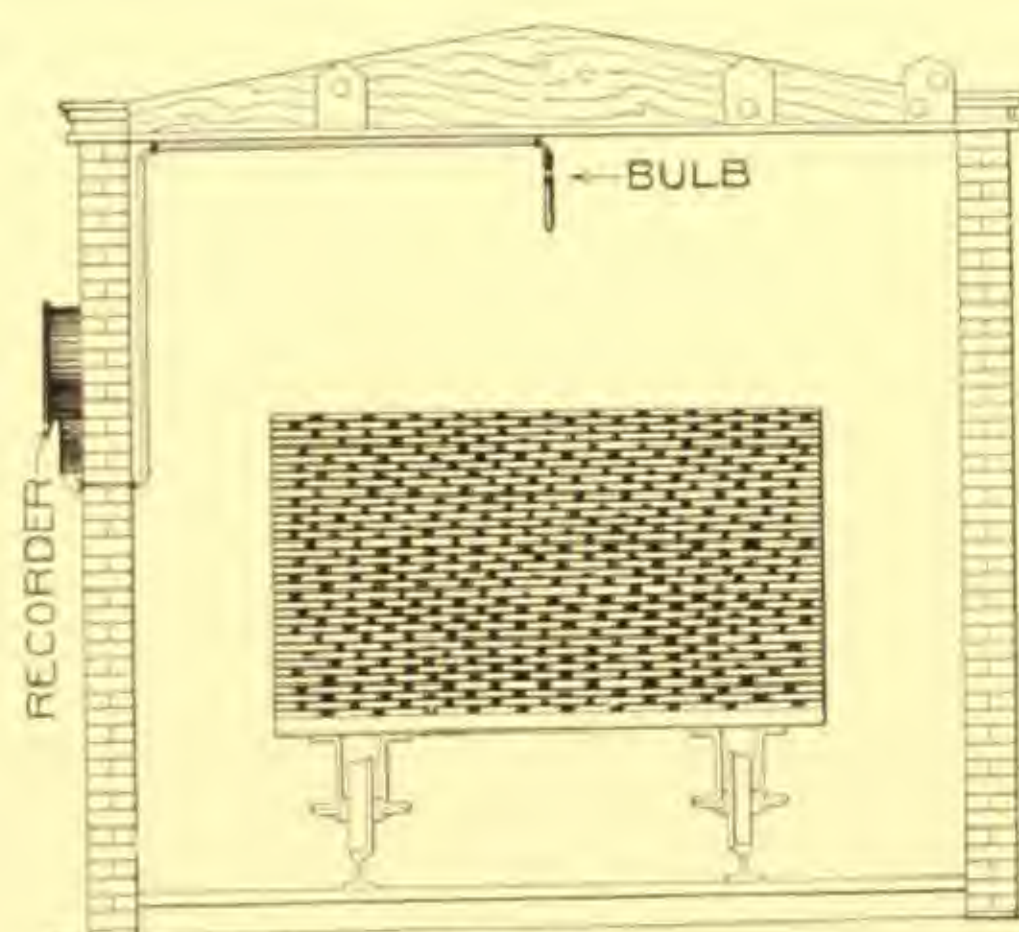


Fig. 238

### Bulbs Installed in Open Spaces

In measuring atmospheric temperatures in Dry Kilns, Drying Ovens, etc., the bulb should be located where it will be subjected to free circulation of atmosphere the temperature of which is to be recorded. Usually suspended centrally at the top is the most practical and satisfactory way, and has the advantage of uninterrupted circulation and out of the way of materials being placed below for treatment. This method of installation is shown diagrammatically in Fig. 238, and clearly shows the advantage of the long distance feature of Bristol's Class II Recording Thermometers.



## RELATIVE ELEVATION OF BULB AND RECORDER

ALWAYS specify bulb elevation as per item No. 14 of Directions for Ordering on page 38 when ordering Bristol's Class II Recording Thermometers. If Bulb is to be installed higher than Recorder, specify dimension "A" as per Fig. 831. For Bulb installed on same level as Recorder, specify as per Fig. 832, and Bulb installed lower than Recorder, specify as per Fig. 833.

NOTE—If the sensitive Bulb is installed at the same level as the base of the Recording Instrument, it is immaterial whether the connecting tube between the Bulb and Recorder is installed in a straight line between the Recorder and the Bulb. For example, if the Bulb is on the same level as the base of the Recorder, the connecting tube may be run up to the ceiling, over and down to the bulb, or it may be dropped down and run under the floor then up to the bulb. The important thing to know is whether the base of the Instrument and the Bulb are on the same level.

Unless otherwise specified Bristol's Class II Recording Thermometers are calibrated for the Bulb and Instrument to be installed at the same level.

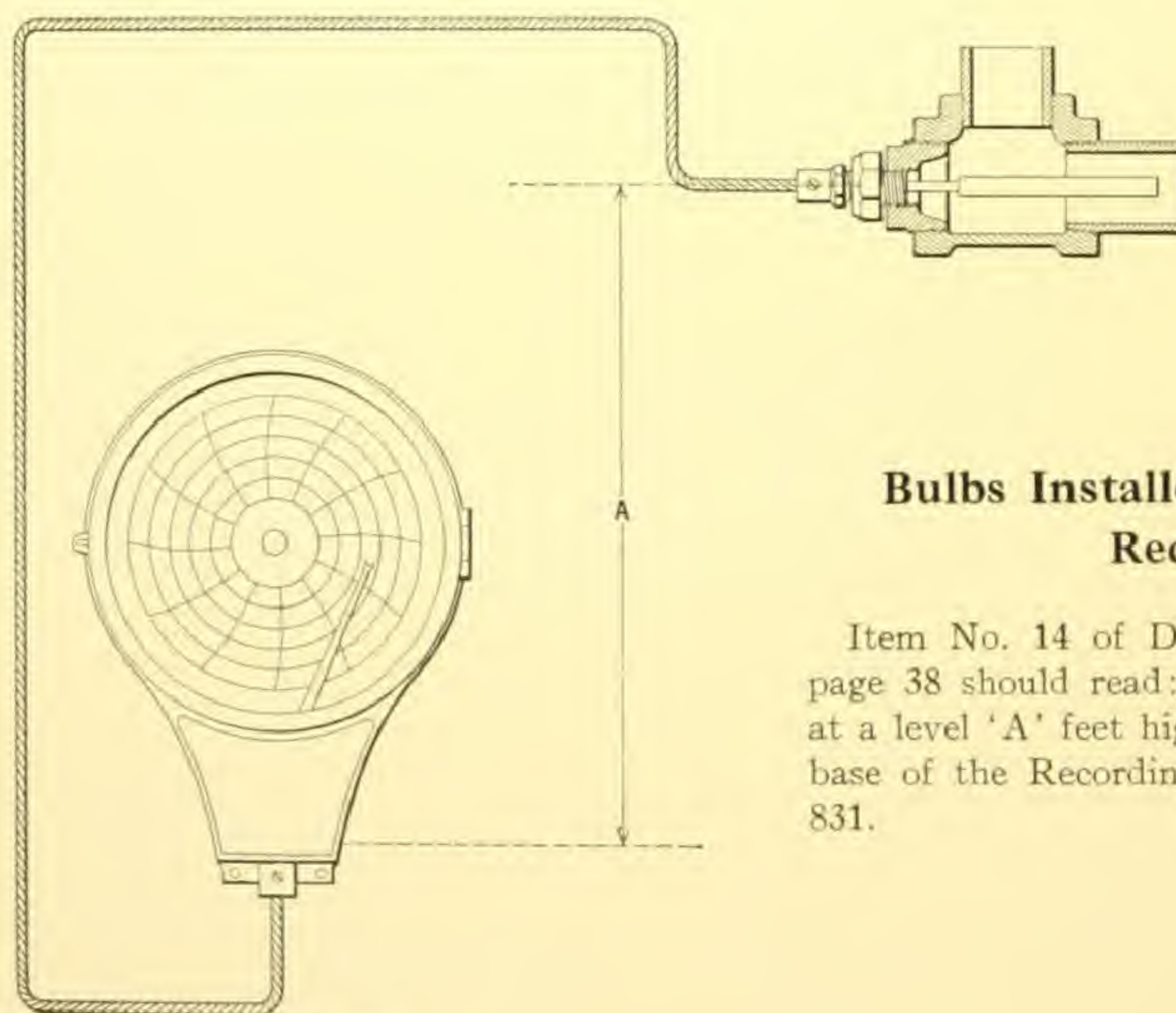


Fig. 831

### Bulbs Installed Higher Than Recorder

Item No. 14 of Directions for Ordering on page 38 should read: "Bulb will be installed at a level 'A' feet higher than the level of the base of the Recording Instrument." See Fig. 831.



## RELATIVE ELEVATION OF BULB AND RECORDER

### Bulbs Installed at Same Level as Recorder

Item No. 14 of Directions for Ordering on page 38 should read: "Bulb will be installed at same level as base of Recording Instrument." See Fig. 832.

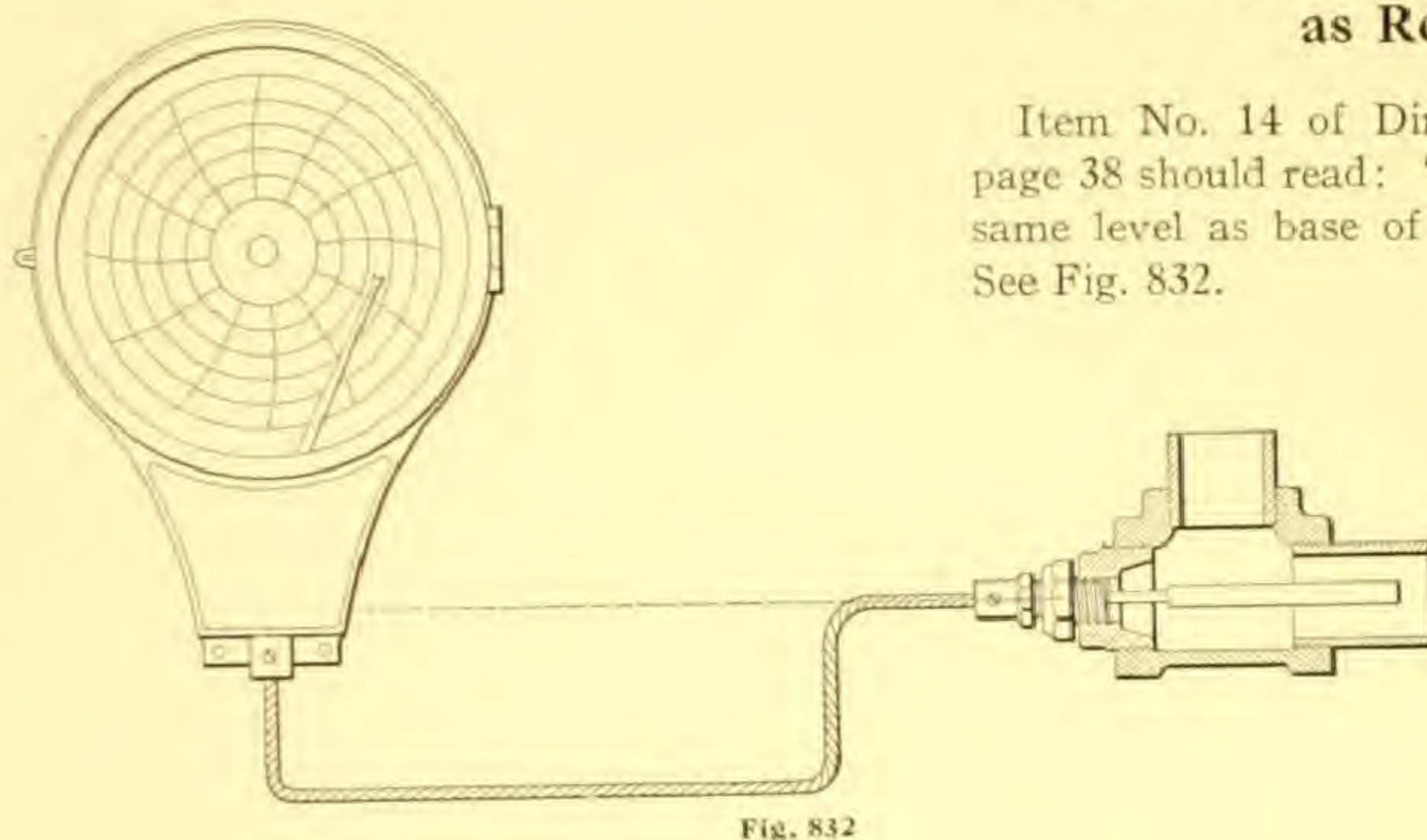


Fig. 832

### Bulbs Installed Lower Than Recorder

Item No. 14 of Directions for Ordering on page 38 should read: "Bulb will be installed at a level 'B' feet lower than the level of the base of the Recording Instrument." See Fig. 833.

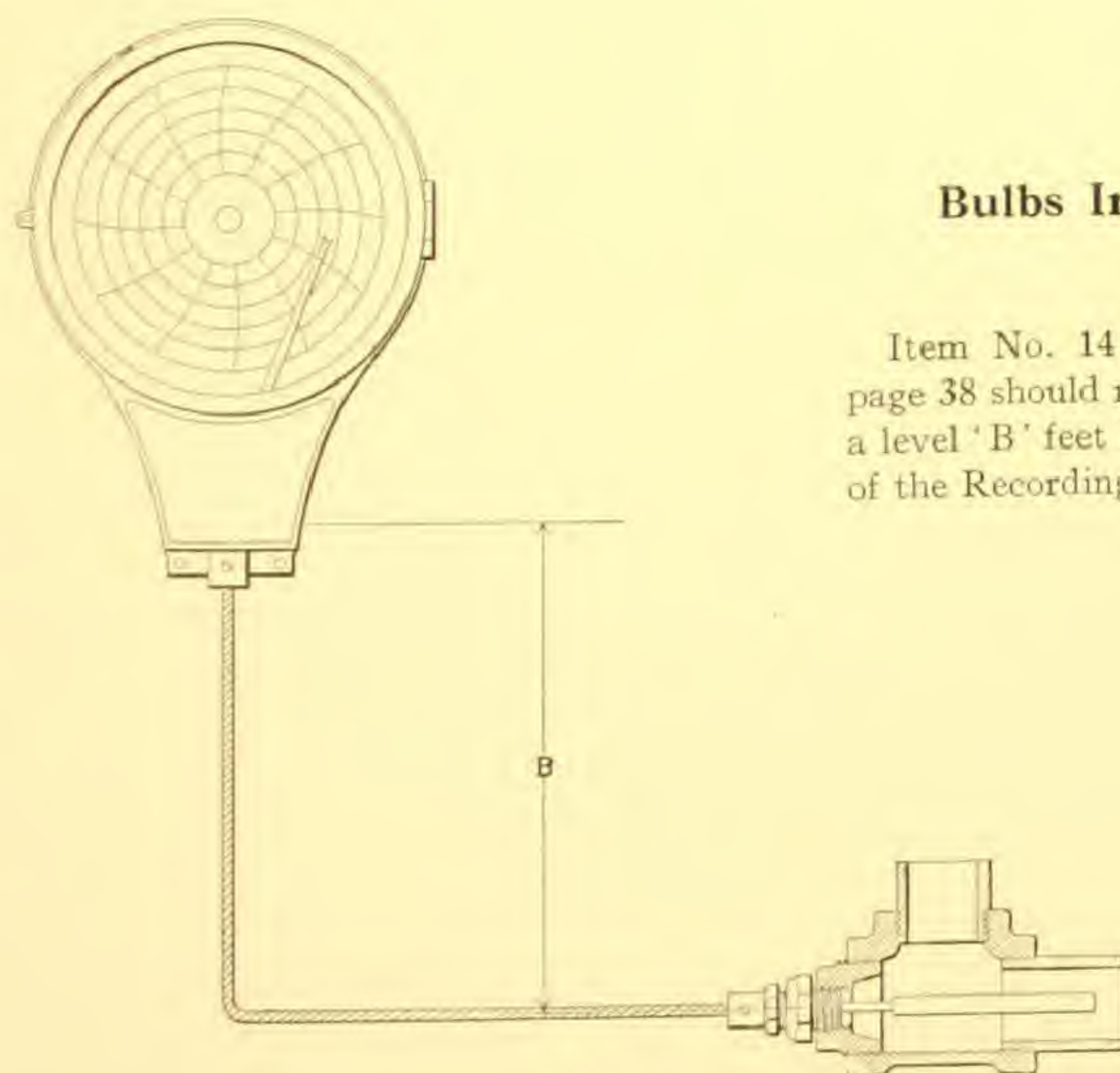


Fig. 833



## DIRECTIONS FOR ORDERING

In ordering Bristol's Class II Recording Thermometers specify the following:

1. MODEL NUMBER of recording Instrument.
2. FINISH of recording instrument.  
(Black Enamel is standard finish on all models except 212, which is wood, and will be furnished unless otherwise specified.)
3. ARRANGEMENT OF CONNECTIONS of recording instrument, i. e., "front connected" or "back connected."  
(Front connected instruments are standard, and will be furnished unless otherwise specified.)
4. MAXIMUM TEMPERATURE to which sensitive bulb will ever be exposed.
5. AVERAGE WORKING TEMPERATURE to be recorded.
6. MINIMUM TEMPERATURE of which it is important to have a clear record.  
NOTE.—Bristol's Class II Recording Thermometers as regularly calibrated are only to be used to record bulb temperatures higher than the temperature to which the recorder and connecting tube are subjected.
7. SIZE OF CHART or dial, i. e., 12-inch, 10-inch, 8-inch, or 6-inch.
8. REVOLUTION OF CHART, i. e., 7-day, 24-hour, 12-hour, or 1-hour, etc.
9. CHART NUMBER.
10. KIND OF FLEXIBLE CONNECTING TUBE, i. e., bronze-armored, steel-armored, or lead-armored.
11. LENGTH OF FLEXIBLE CONNECTING TUBE needed between recording instrument and sensitive bulb.  
(Standard length, 25 feet.) and will be furnished unless otherwise specified.
12. BULB NUMBER. In selecting bulb it should be remembered that the entire sensitive portion should be immersed or exposed to the medium or temperature of which a record is desired.
13. APPLICATION for which recording instrument is to be used.  
(In ordering these thermometers it is often desirable for the customer to submit a sketch outlining method of applying sensitive bulb.)
14. ELEVATION of bulb in comparison with the base of recording instrument (see pages 36 and 37.)  
i. e. (A) "Bulb will be installed at a level—'A'—feet higher than the level of the base of the recording instrument." (See Fig. 831, page 36.)  
or (B) "Bulb will be installed at same level as base of recording instrument."  
or (C) "Bulb will be installed at a level—'B'—feet lower than the level of the base of the recording instrument."  
(Unless otherwise specified Bristol's Class II Recording Thermometers are furnished to record correctly, when bulb is installed at same level as base of recording instrument.)

## TELEGRAPHIC ORDERS

In ordering regularly listed Bristol Class II Recording Thermometers to be furnished with standard finishes and complete with standard lengths of connecting tube and standard bulbs, as listed on pages 28 to 34, the orders for these may be specified more briefly as follows:

- (1) MODEL NUMBER    (2) CHART NUMBER    (3) BULB NUMBER



## DRILLING DIMENSIONS

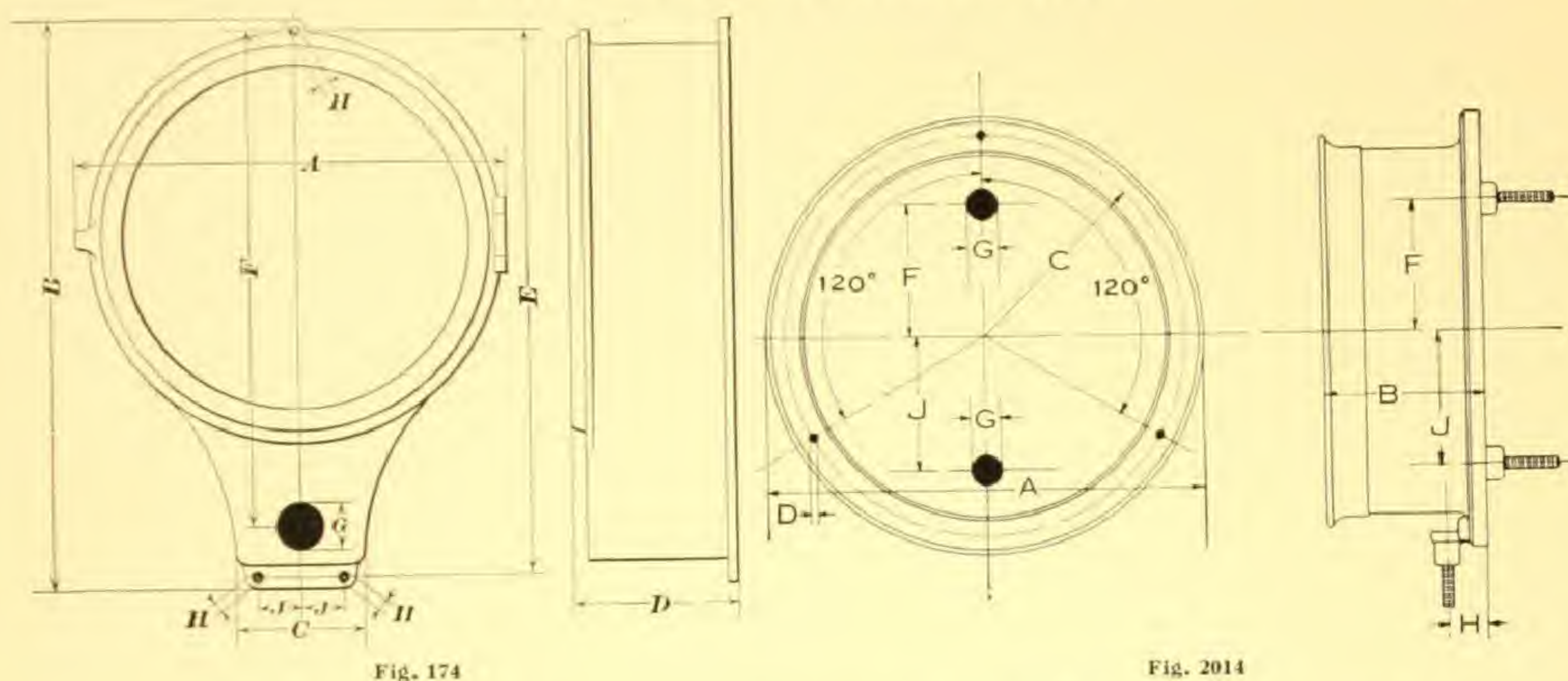


Fig. 174

Fig. 2014

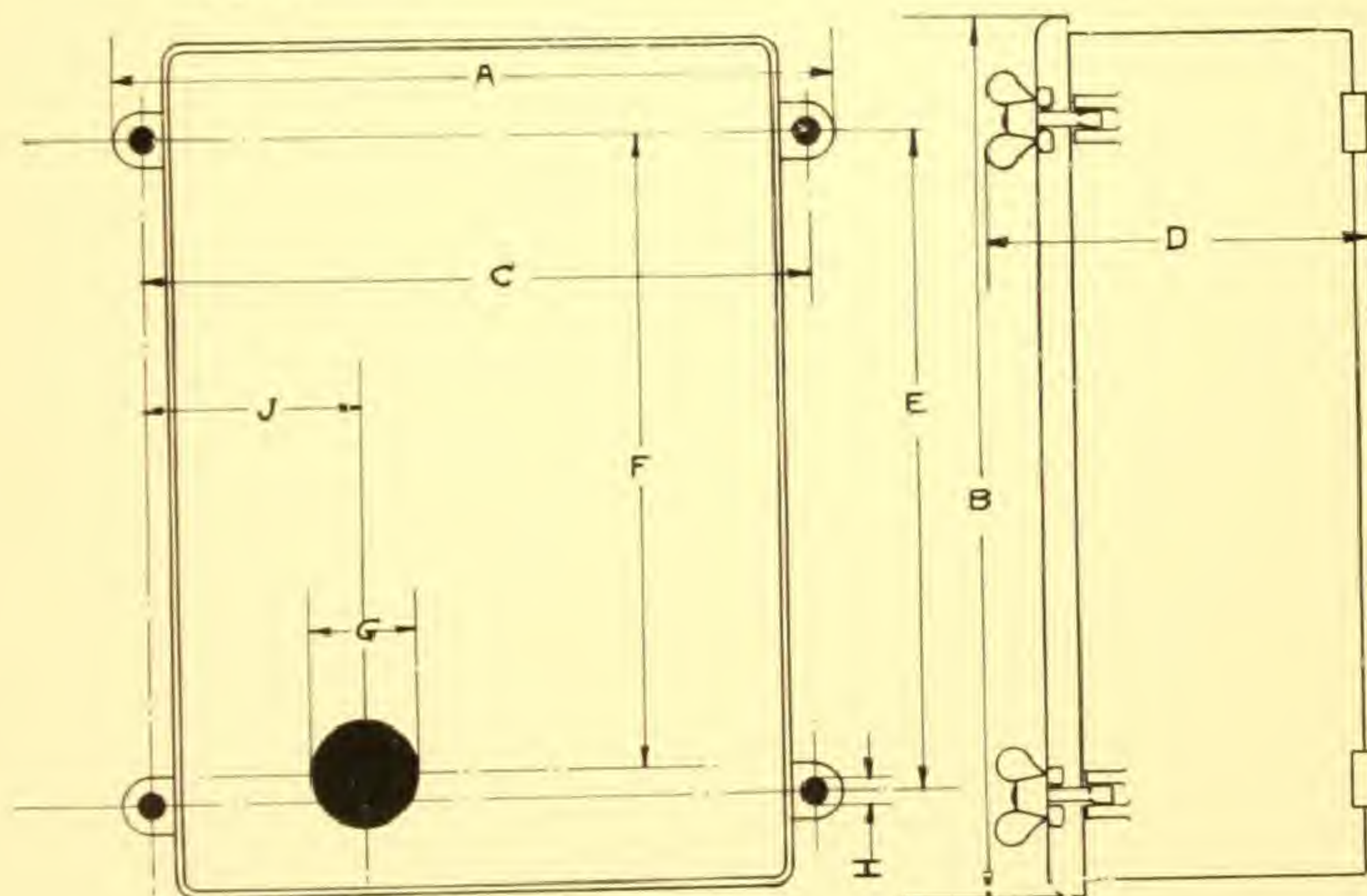


Fig. 1681

MODEL NO.	SIZE CHART	FIGURE NO.	DIMENSIONS IN INCHES								
			A	B	C	D	E	F	G	H	J
211	12-inch	174	13 1/2"	17 1/8"	4 3/8"	3 3/8"	17 5/16"	16 5/16"	Variable	1/4"	1 5/8"
211	8-inch	174	10 "	13 1/4"	3 3/8"	3 3/8"	12 1/16"	11 1/16"	Variable	1/4"	1 "
240	12-inch	1681	14 5/8"	18 "	13 1/2"	5 1/2"	12 3/8"	13 "	Variable	3/8"	3 1/4"
240	8-inch	1681	11 "	13 "	9 3/8"	4 3/4"	9 7/8"	9 3/16"	Variable	3/8"	2 3/16"
247	6-inch	2014	10 5/8"	3 3/4"	4 3/32"	1/4"		None	Variable	1 3/16"	3 9/10"
								Back Connected Inverted		Front Conn't'd	B. C. Upright
241	8-inch	2014	11 1/8"	4 1/8"	5 1/8"	1/4"		3 3/8"	Variable	1 3/16"	3 7/8"
241	10-inch	2014	13 1/4"	4 1/8"	6 1/16"	1/4"		4 7/8"	Variable	1 3/16"	4 7/8"

ELECTRICITY

MOTION, ETC.



## LIST PRICES

Prices given below are for standard finish case and 25-foot armored capillary connecting tube. With each instrument is included 100 Charts, bottle of Bristol's Special Recording Instrument Ink, Padlock and Key. See "Note" at bottom of this page.

BULB		INSTRUMENT		CHART			
No.	Shown on Page	Model No.	Shown on Page	12-Inch	10-Inch	8-Inch	6-Inch
202	28	211	4	\$79.00	—	\$68.00	—
		240	6	84.00	—	73.00	—
		212	7	84.00	—	73.00	—
		241	8	—	\$62.00	57.00	—
		247	9	—	—	—	\$51.00
4202	28	211	4	82.00	—	71.00	—
		240	6	87.00	—	76.00	—
		212	7	87.00	—	76.00	—
		241	8	—	65.00	60.00	—
		247	9	—	—	—	54.00
6202	28	211	4	89.50	—	78.50	—
		240	6	94.50	—	83.50	—
		212	7	94.50	—	83.50	—
		241	8	—	72.50	67.50	—
		247	9	—	—	—	61.50
204	34	211	4	80.00	—	69.00	—
		240	6	85.00	—	74.00	—
		212	7	85.00	—	74.00	—
		241	8	—	63.00	58.00	—
		247	9	—	—	—	52.00
207	30	211	4	85.00	—	74.00	—
		240	6	90.00	—	79.00	—
		212	7	90.00	—	79.00	—
		241	8	—	68.00	63.00	—
		247	9	—	—	—	57.00
222	29	211	4	80.00	—	69.00	—
		240	6	85.00	—	74.00	—
		212	7	85.00	—	74.00	—
		241	8	—	63.00	58.00	—
		247	9	—	—	—	52.00
4222	32	211	4	80.00	—	69.00	—
		240	6	85.00	—	74.00	—
		212	7	85.00	—	74.00	—
		241	8	—	63.00	58.00	—
		247	9	—	—	—	52.00
232	31	211	4	84.00	—	73.00	—
		240	6	89.00	—	78.00	—
		212	7	89.00	—	78.00	—
		241	8	—	67.00	62.00	—
		247	9	—	—	—	56.00
2232	31	211	4	93.00	—	82.00	—
		240	6	98.00	—	87.00	—
		212	7	98.00	—	87.00	—
		241	8	—	76.00	71.00	—
		247	9	—	—	—	65.00

FINISHES—Black Enamel is the Standard Finish for all cases except Model 212, which is wood. All models except Nos. 240, 241 and 212 may be furnished in full nickel finish at a slightly increased price (quoted on request).

CONNECTING TUBE—Twenty-five feet is standard length of connecting tube and will be furnished unless otherwise specified. For shorter lengths, not less than 5-feet of tubing, deduct 44 cents per foot; for longer lengths add 44 cents per foot.

ARRANGEMENT OF CONNECTIONS—"Front Connected" or "Back Connected." (Front connected instruments are standard, and will be furnished unless otherwise specified.) For "Back Connected" add \$5.50 extra list.

All Prices on this page are F. O. B. Waterbury, Conn.



## LIST PRICES

Prices given below are for standard finish case and 25-feet armored capillary connecting tube. With each instrument is included 100 Charts, bottle of Bristol's Special Recording Instrument Ink, Padlock and Key. See "Note" at bottom of this page.

BULB		INSTRUMENT		CHART			
No.	Shown on Page	Model No.	Shown on Page	12-Inch	10-Inch	8-Inch	6-Inch
1242	31	211	4	\$82.00	—	\$71.00	—
		240	6	87.00	—	76.00	—
		212	7	87.00	—	76.00	—
		241	8	—	\$65.00	60.00	—
		247	9	—	—	—	\$54.00
252	34	211	4	82.00	—	71.00	—
		240	6	87.00	—	76.00	—
		212	7	87.00	—	76.00	—
		241	8	—	65.00	60.00	—
		247	9	—	—	—	54.00
253	34	211	4	82.00	—	71.00	—
		240	6	87.00	—	76.00	—
		212	7	87.00	—	76.00	—
		241	8	—	65.00	60.00	—
		247	9	—	—	—	54.00
282	29	211	4	82.00	—	71.00	—
		240	6	87.00	—	76.00	—
		212	7	87.00	—	76.00	—
		241	8	—	65.00	60.00	—
		247	9	—	—	—	54.00
1282	32	211	4	83.00	—	72.00	—
		240	6	88.00	—	77.00	—
		212	7	88.00	—	77.00	—
		241	8	—	66.00	61.00	—
		247	9	—	—	—	55.00
292	30	211	4	85.00	—	74.00	—
		240	6	90.00	—	79.00	—
		212	7	90.00	—	79.00	—
		241	8	—	68.00	63.00	—
		247	9	—	—	—	57.00
4292	33	211	4	85.00	—	74.00	—
		240	6	90.00	—	79.00	—
		212	7	90.00	—	79.00	—
		241	8	—	68.00	63.00	—
		247	9	—	—	—	57.00
7292	33	211	4	85.00	—	74.00	—
		240	6	90.00	—	79.00	—
		212	7	90.00	—	79.00	—
		241	8	—	68.00	63.00	—
		247	9	—	—	—	57.00

FINISHES—Black Enamel is the Standard Finish for all cases except Model 212, which is wood. All models except Nos. 240, 241 and 212 may be furnished in full nickel finish at a slightly increased price (quoted on request).

CONNECTING TUBE—Twenty-five feet is Standard length of connecting tube and will be furnished unless otherwise specified. For shorter lengths, not less than 5-feet of tubing, deduct 44 cents per foot; for longer lengths add 44 cents per foot.

ARRANGEMENT OF CONNECTIONS—"Front Connected" or "Back Connected." (Front connected instruments are standard, and will be furnished unless otherwise specified.) For "Back Connected" add \$5.50 extra list.

All Prices on this page are F. O. B. Waterbury, Conn.



## ADDITIONAL SUPPLIES

### CHARTS

All charts for Bristol's Recording Instruments are numbered, and to avoid delay in delivery, the Chart Number should be specified on all orders for charts.

The name and address of The Bristol Company is printed near the center of all genuine Bristol's Round Charts and on the side of the Strip Charts. Bristol's Recording Instruments are guaranteed to be accurate only when charts bearing the name of The Bristol Company are used.

Bristol's Round Charts are sold by the hundred. When placing orders specify by the hundred or multiple thereof. If otherwise specified, we reserve the right to change to the nearest multiple of 100. Strip Charts are sold by the roll 90 and 30 feet in length. With each new Round Chart Type Recorder are included 100 Charts. With new Strip Type Recorder is included one 90-ft. chart roll.

#### LIST PRICES

<b>BRISTOL'S ROUND CHART, 12-Inch and 10-Inch Diameter,</b>	
Per 100 .....	\$1.65
Printed in copying ink, per 100 .....	1.90
7-Day, printed in two colors, per 100 .....	2.20
Onion-skin paper, per 100 .....	2.75
Smoked surface, per 100 .....	4.40
<b>BRISTOL'S ROUND CHART, 8-Inch and 6-Inch Diameter,</b>	
Per 100 .....	.80
Printed in copying ink, per 100 .....	.95
7-Day, printed in two colors, per 100 .....	1.35
Onion-skin paper, per 100 .....	1.65
Smoked surface, per 100 .....	2.75
<b>BRISTOL'S STRIP CHART, per roll 90 feet long</b> .....	1.10
per roll 30 feet long .....	.45

### INK

With each Recording Instrument is furnished a bottle of Special Recording Instrument Ink, a combination rubber stopper and glass filler. To obtain satisfactory Records use this Special Ink only.

The standard color of this special ink is red, but other colors can be furnished to order for use in making records on "onionskin" sheets to be blue-printed.

#### LIST PRICES

<b>BRISTOL'S SPECIAL RECORDING INSTRUMENT INK,</b>	
One-ounce Bottle .....	\$ .30
Two-ounce Bottle .....	.45
Four-ounce Bottle .....	.65
Half-pint Bottle .....	1.10
Pint Bottle .....	1.90
Quart Bottle .....	3.30
<b>COMBINATION RUBBER STOPPER AND GLASS FILLER.</b> .....	.10

### FIXATIVE FOR SMOKED CHARTS

#### LIST PRICES

Fixative Solution for Smoked Charts, per quart can .....	\$ .80
Special Glass Jar for fixing 8-Inch Smoked Charts .....	.30

### CHART HOLDER

#### LIST PRICES

Chart Holder for 8-Inch Round Chart .....	\$2.20
Chart Holder for 12-Inch Round Chart .....	2.75
When ordering Chart Holders, specify whether for wall or shelf use.	

All Prices on this page are F. O. B. Waterbury, Conn.



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REG. U. S. PAT. OFFICE

## RECORDING WET AND DRY-BULB THERMOMETER MODEL 211

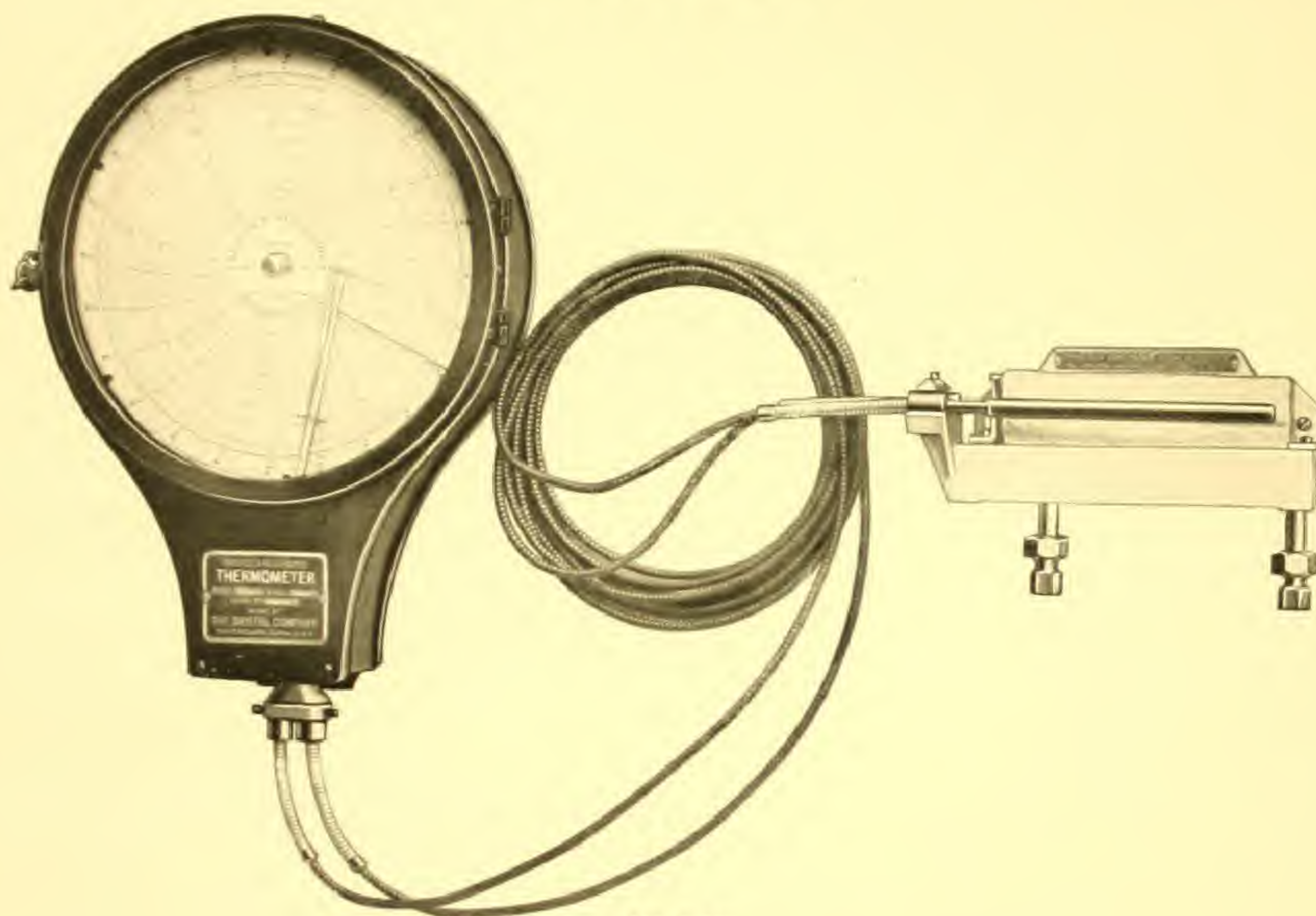


Fig. 1780

Bristol's Recording Wet and Dry-Bulb Thermometer shown here is an adaption of the standard two-pen Bristol's Vapor Pressure, or Class II Recording Thermometer with adjusted bulb. This type of instrument is noted for simplicity of construction, accuracy and sensitivity in operation. They can be calibrated for practically all ranges between freezing and the boiling point of water. The instrument has two complete operating systems, including two bulbs and two pens: both pens recording on the same chart. One system records the temperature of the dry-bulb, or atmosphere; the other the temperature of a bulb kept constantly moist, and known as the wet-bulb.

The operation of Bristol's Recording Wet and Dry-Bulb Thermometer is based on the principle that evaporation varies with the amount of moisture in the atmosphere. The temperature of the wet-bulb is always lower than the surrounding atmosphere. The difference in the temperature readings of the wet-bulb and dry-bulb is known as the wet-bulb depression. This varies directly with the rate of evaporation, which rate is inversely proportional to the amount of water vapor in the air, at the indicated atmospheric temperature. By taking the dry-bulb temperature and noting the wet-bulb depression, the relative humidity in percent can be readily ascertained from the table furnished.

Prices Quoted on Request

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TRADE MARK  
**BRISTOL'S**  
 REG. U. S. PAT. OFFICE.



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 WATERBURY, CONN., U. S. A.

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DENVER  
 U. S. National Bank Bldg.

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### THE MOST EXTENSIVE LINE OF RECORDING INSTRUMENTS IN THE WORLD

#### PRESSURE AND VACUUM

Bristol's Recording Pressure and Vacuum Gauges

#### LIQUID LEVEL

Bristol's Recording Water Level Gauges  
 Bristol-Derr Water Level Gauges for Steam Boilers

#### TEMPERATURE

Bristol's Class I Recording Thermometers

Bristol's Class II Recording Thermometers

Bristol's Class III Recording Thermometers

Wm. H. Bristol Indicating and Recording Electric Pyrometers

Bristol's Temperature Controllers

#### HUMIDITY

Recording Wet and Dry Bulb Thermometers

#### ELECTRICITY

Bristol's Recording Voltmeters

Bristol's Recording Ammeters

Bristol's Recording Wattmeters

Wm. H. Bristol Recording Milli Voltmeters

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#### TIME

Bristol's Electric Time Recorders

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Bristol-Durand Radii Averaging Instruments

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**Bristol's Patent Steel Belt Lacing—The Perfect Fastener for All Kinds of Belts**



# BRISTOL'S



RECORDING THERMOMETERS  
GAS FILLED

for temperatures between 90° below zero  
and 1100° F.

THE BRISTOL COMPANY  
WATERBURY, CONN. U. S. A.

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## Introductory

Nitrogen gas under pressure is used in the working system of Bristol's Gas Filled Recording Thermometers. For many years scientists considered the gas filled thermometer as the ideal, but difficult to make. However, The Bristol Company, with over thirty-five years of experience, are able to offer a gas filled recording thermometer, which has in actual use, proved to be thoroughly efficient and practical.

Very definite characteristics are inherent in the gas filled type of thermometer. (1) It insures a uniformly graduated chart scale over the entire range. (2) The temperature range is greater than with some other methods.

All temperature ranges between  $60^{\circ}$  below zero and  $1000^{\circ}\text{F}$ . are covered by Bristol Gas Filled Recording Thermometers. Where it is required to record the low temperatures, a patented compensator is used, which corrects the atmospheric temperature at the instrument. Thus, the thermometer operates just as accurately in the lower ranges as in the higher.

The variety of scale ranges and mechanical fittings make Bristol's Gas Filled Recording Thermometers adaptable for an almost unlimited number of uses in the industrial plant. Some of the uses are listed throughout the catalog.

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## Simplicity

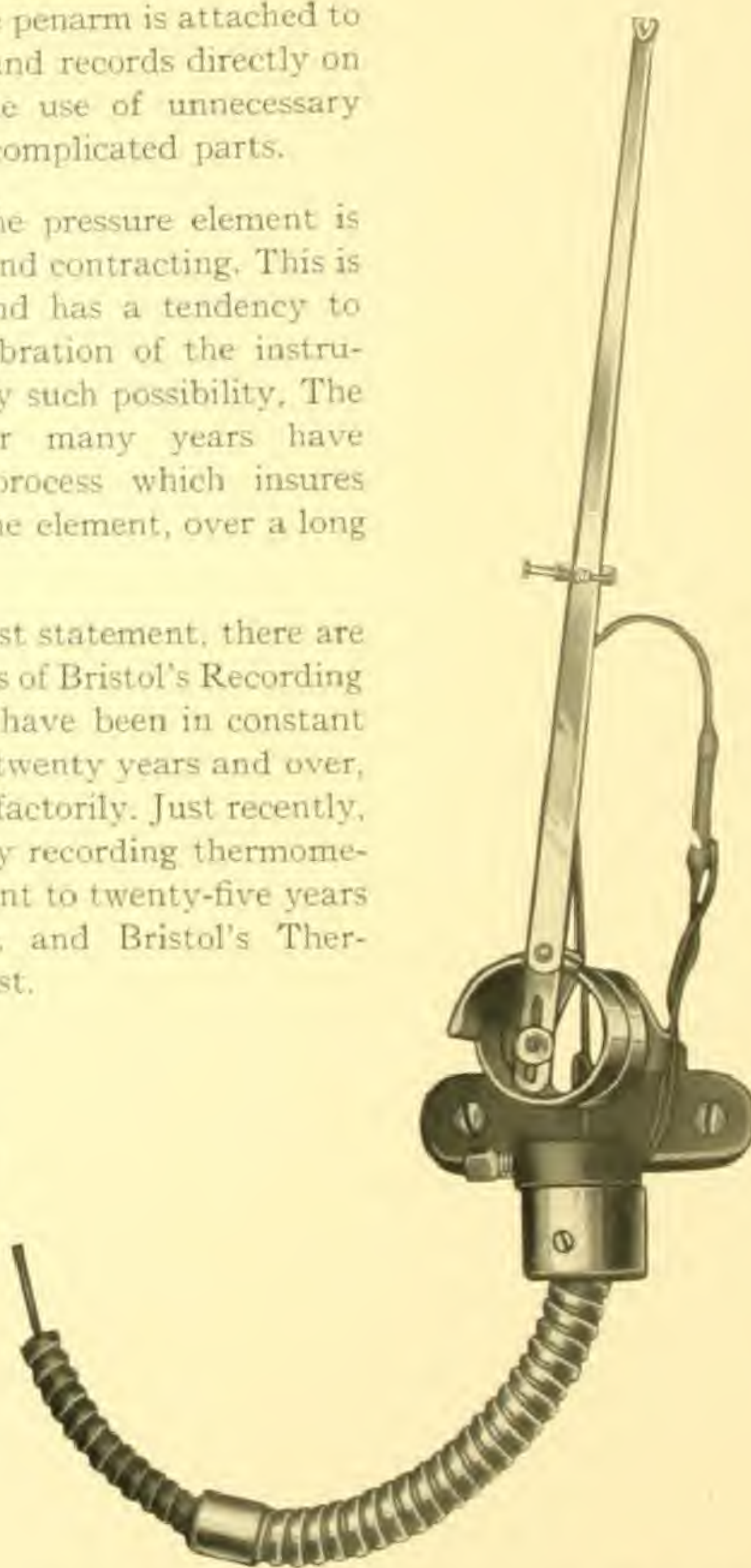
The illustrations on this page show the pressure elements with penarm, as used with Bristol's Recording Thermometers. They probably illustrate better than any other way, the utmost simplicity in construction of the instrument. It shows how the penarm is attached to the pressure element, and records directly on the chart, without the use of unnecessary gears, levers or other complicated parts.

When operating, the pressure element is constantly expanding and contracting. This is a continuous strain and has a tendency to unset the original calibration of the instrument. To overcome any such possibility, The Bristol Company, for many years have employed an aging process which insures reliable operation of the element, over a long period of time.

As a proof of the last statement, there are in our files many reports of Bristol's Recording Thermometers, which have been in constant service from fifteen to twenty years and over, and still operating satisfactorily. Just recently, a concern buying many recording thermometers ran a test equivalent to twenty-five years of continuous service, and Bristol's Thermometers stood the test.



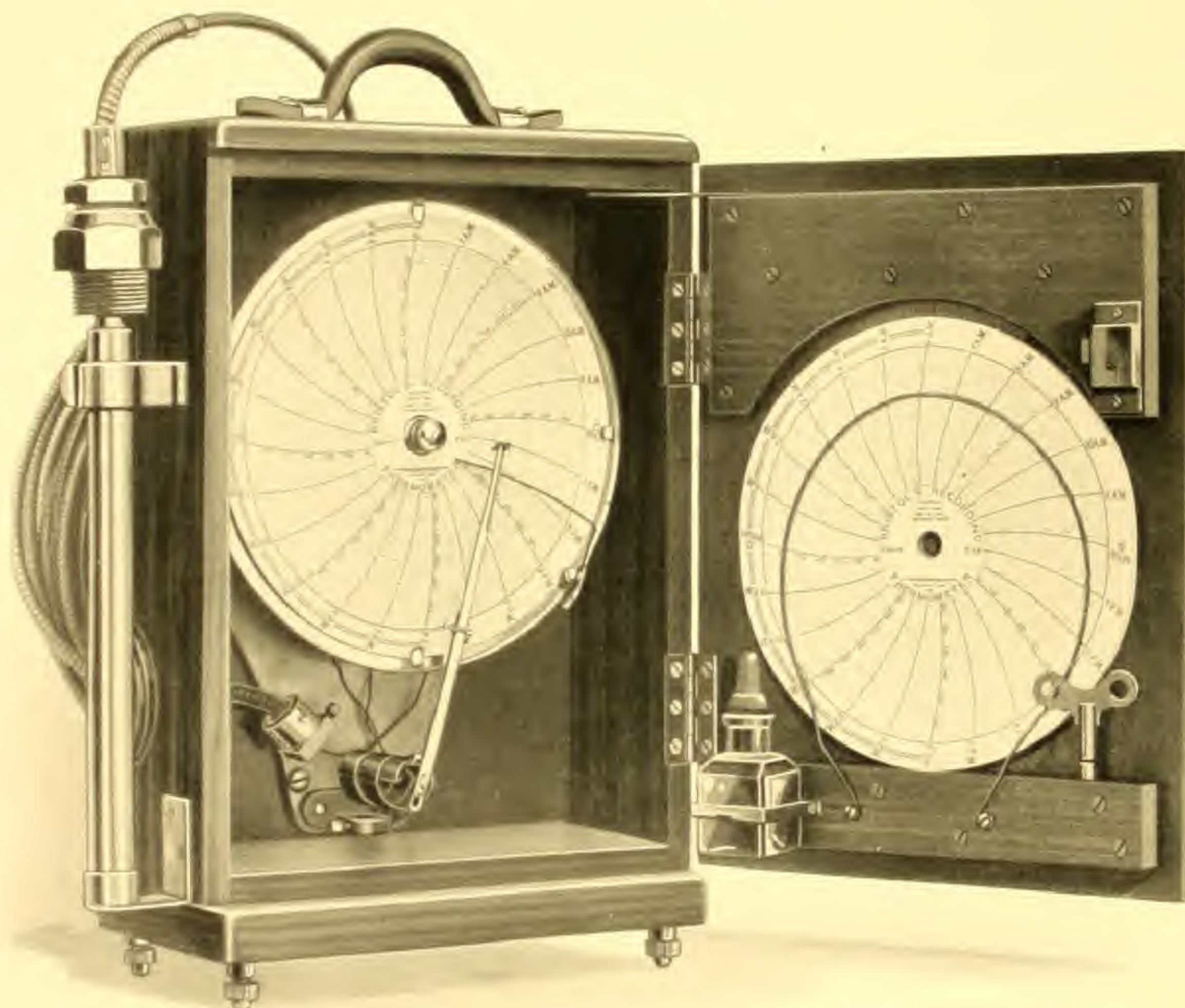
Spiral Type of Pressure Element used in Bristol's Gas Filled Recording Thermometers for lower temperatures.



Helical Form of Pressure Element used with Bristol's Gas Filled Recording Thermometers for higher temperatures.



### Interior Arrangement



**This Portable Model 312 shows the general interior arrangement of Bristol's Gas Filled Recording Thermometers. Notice particularly the relation of pressure element, penarm and chart**

For experimental and test work, this portable recording thermometer has many important uses. Also for such places where only occasional records are required it is very convenient.

This instrument uses the same working parts as the Models 311 and 340. It can be furnished in two sizes, having charts 12-inches or 8-inches in diameter, as listed on pages 38 to 44.

The case is wood with varnish finish. The arrangement is compact and convenient. It is light in weight and with the leather carrying handle is easily portable.

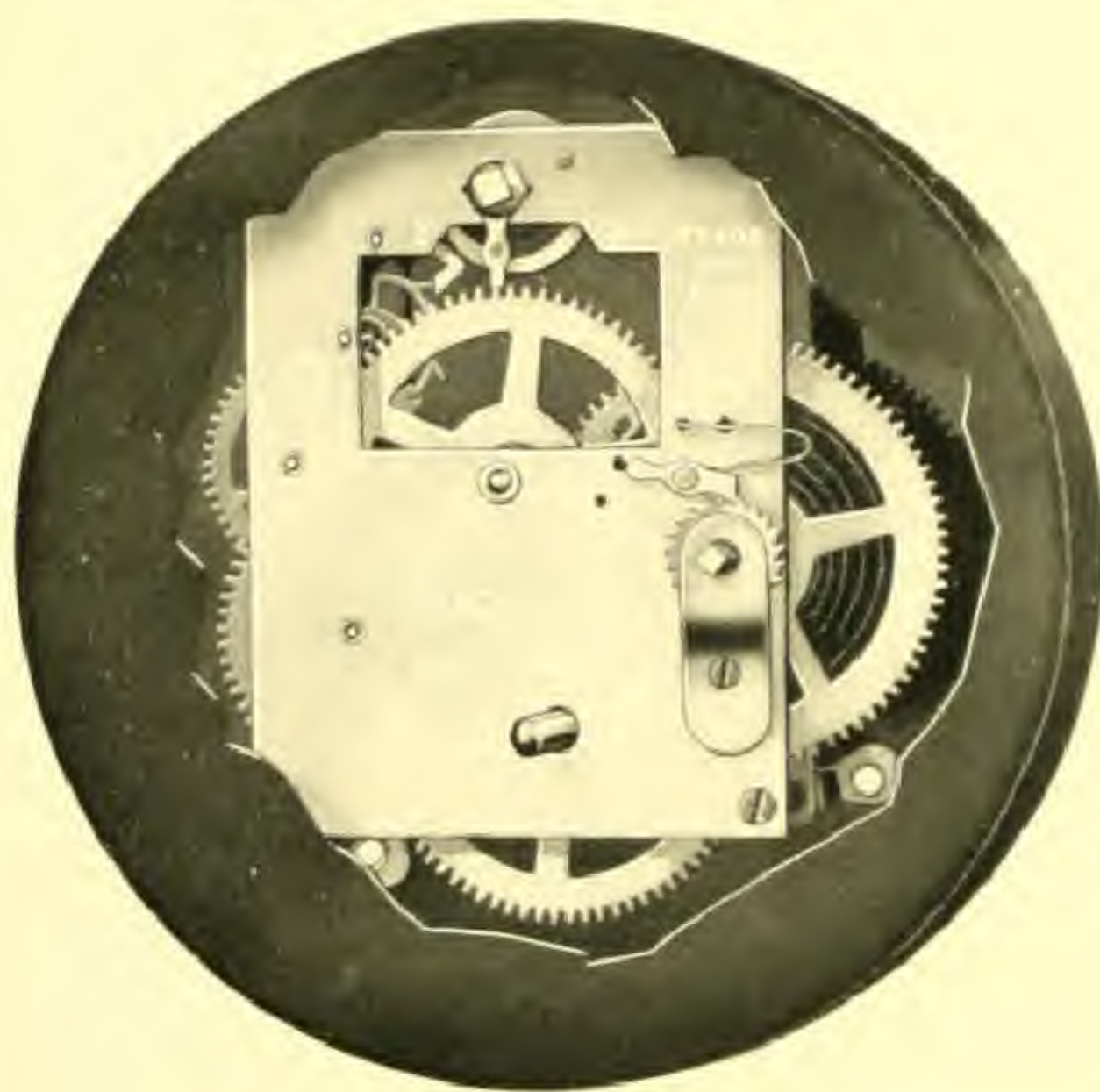
Any bulb shown in this catalog can be furnished with this instrument. The standard length of connecting tube is 25-feet.



## The Clock Back of Bristol's Charts

While the thermometer penarm is recording the temperature on the chart, a clock movement revolves the chart, so that not only the temperature can be read, but also the time at which it occurs is shown. Thus the clock has an important part in the operation of the recording thermometer.

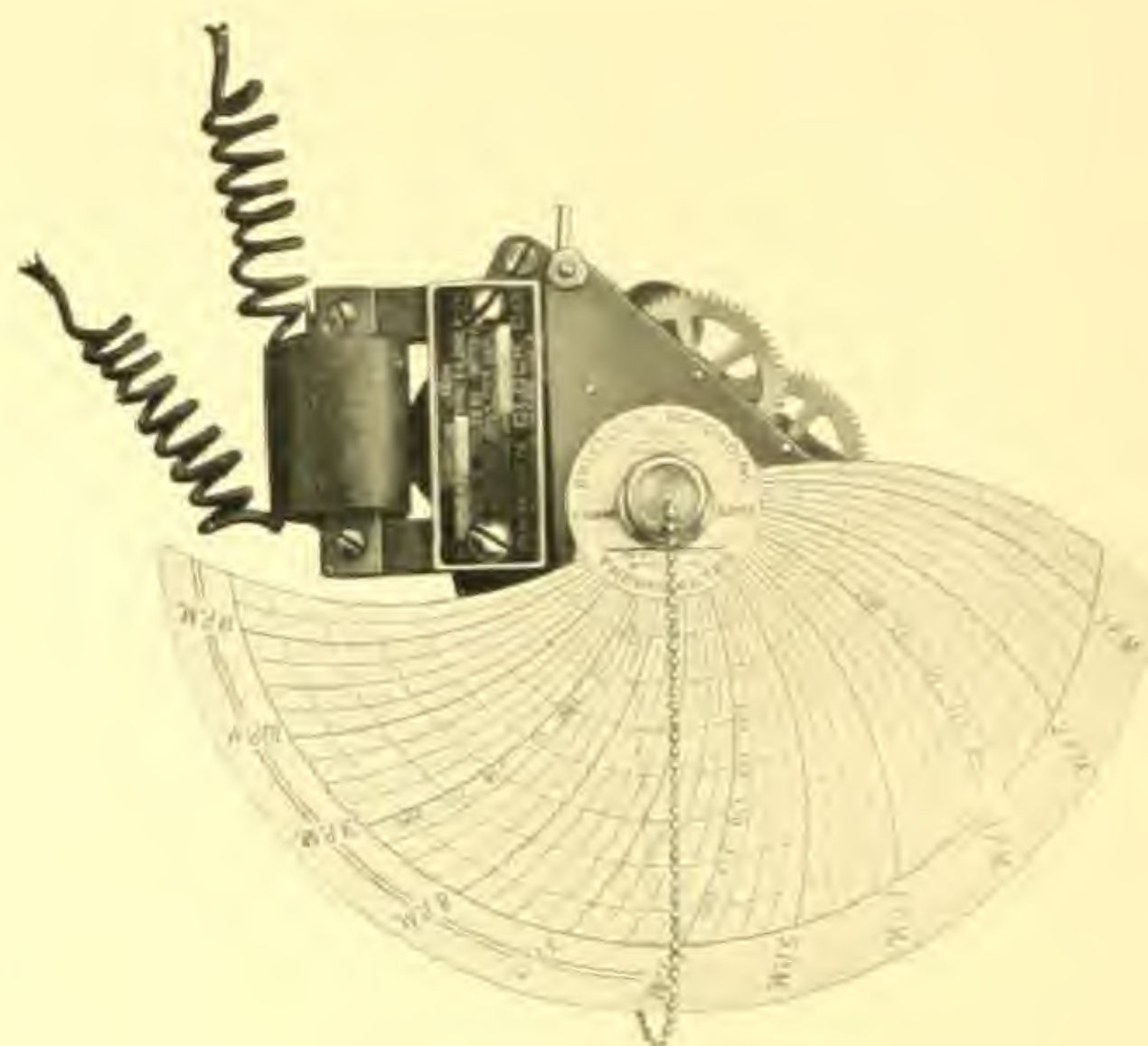
### SPRING WOUND CLOCK



An especially designed "Seth Thomas Clock" movement is used in Bristol's Recording Thermometers. They are made by a company who have been designing and manufacturing clocks for over a century. The reputation for high grade workmanship and time keeping qualities of "Seth Thomas Clock" is well known. They can be depended upon.

To avoid mechanical injury and protection from dust, the clock is mounted in a dust-proof metal container, as illustrated above. It is rarely that these clocks fail to operate except for very unusual causes. In such instances they can be easily removed from the case and returned for replacement or repair.

### MOTOR OPERATED CLOCK



When desired, electrically operated clock can be furnished. It is used in place of a spring wound clock, and, of course, has the advantage of no winding required. For large installations where several recorders are used equipped with the electric clocks, it is possible to have all charts operating in unison.

The electric clock furnished with Bristol's Recorders is the Warren Motor Clock. It operates on alternating current where frequency is known to be constant, or where power system has synchronous frequency. It can be furnished to use for 60, 50, 40 or 25 cycles.

This electric clock is available for 24-hour or 7-day revolutions on round chart recorders, and for 1, 3, 6 or 12-inch per hour speeds on strip chart recorders.

As the Electric Clock is not standard equipment an extra charge is necessary.

Prices quoted on request.



**For Mounting on Wall, Panel-Board or Other Support****BRISTOL'S RECORDING THERMOMETER MODEL 311**

This is the most typical Bristol's Instrument, and probably, the model most generally used.

The interior construction of this instrument is the same as that shown in Model 312 on page 5. By comparison, it will readily be seen how the case has been designed to fit the works, and thus allowing unrestricted space for all moving parts.

The instrument can be furnished in two sizes, having charts 12-inches in diameter or

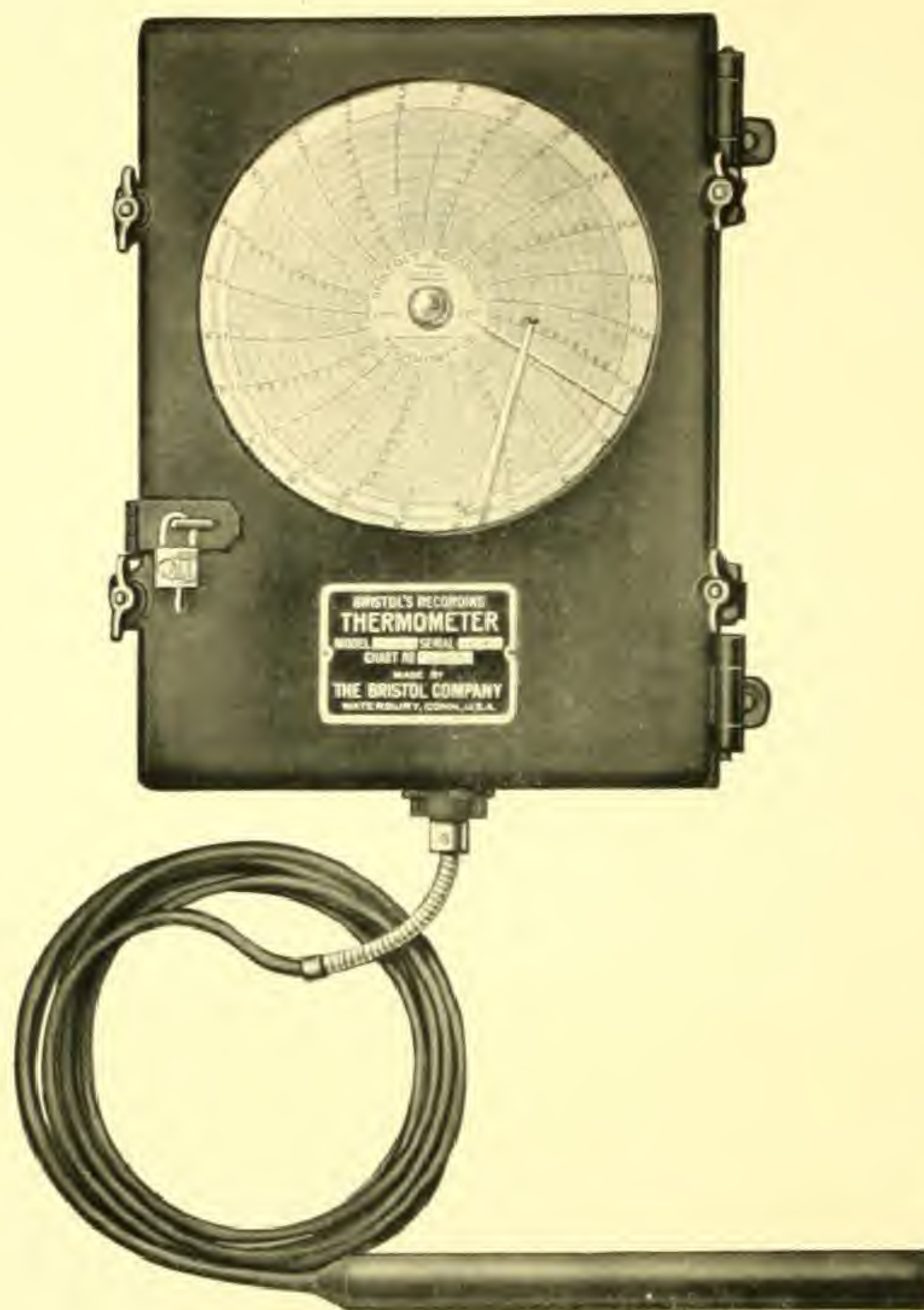
8-inches. For complete list of charts to select from see pages 38 to 44.

The standard finish of the case is black enamel.

25-feet is the standard length of flexible connecting tube furnished with this instrument. However, longer or shorter lengths can be furnished to suit requirements.

Bulbs and fittings to adapt this type of instrument for various applications are shown on pages 22 to 32.



**Moisture-Proof and Dust-Proof Case****BRISTOL'S RECORDING THERMOMETER****RECTANGULAR MODEL 340**

Many times it is necessary to install a recording thermometer in locations where there is considerable moisture, chemical fumes, dust or dirt in the atmosphere, which in a short time would deteriorate the working parts of the instrument. For such places this rugged cast iron case with moisture-proof and dust-proof features should be used.

This instrument also uses the same interior construction as the models 311 and 312. It can be furnished in two sizes, for use with

charts 12-inches in diameter or 8-inches. See pages 38 to 44 for selection of charts.

The standard finish for case is black enamel.

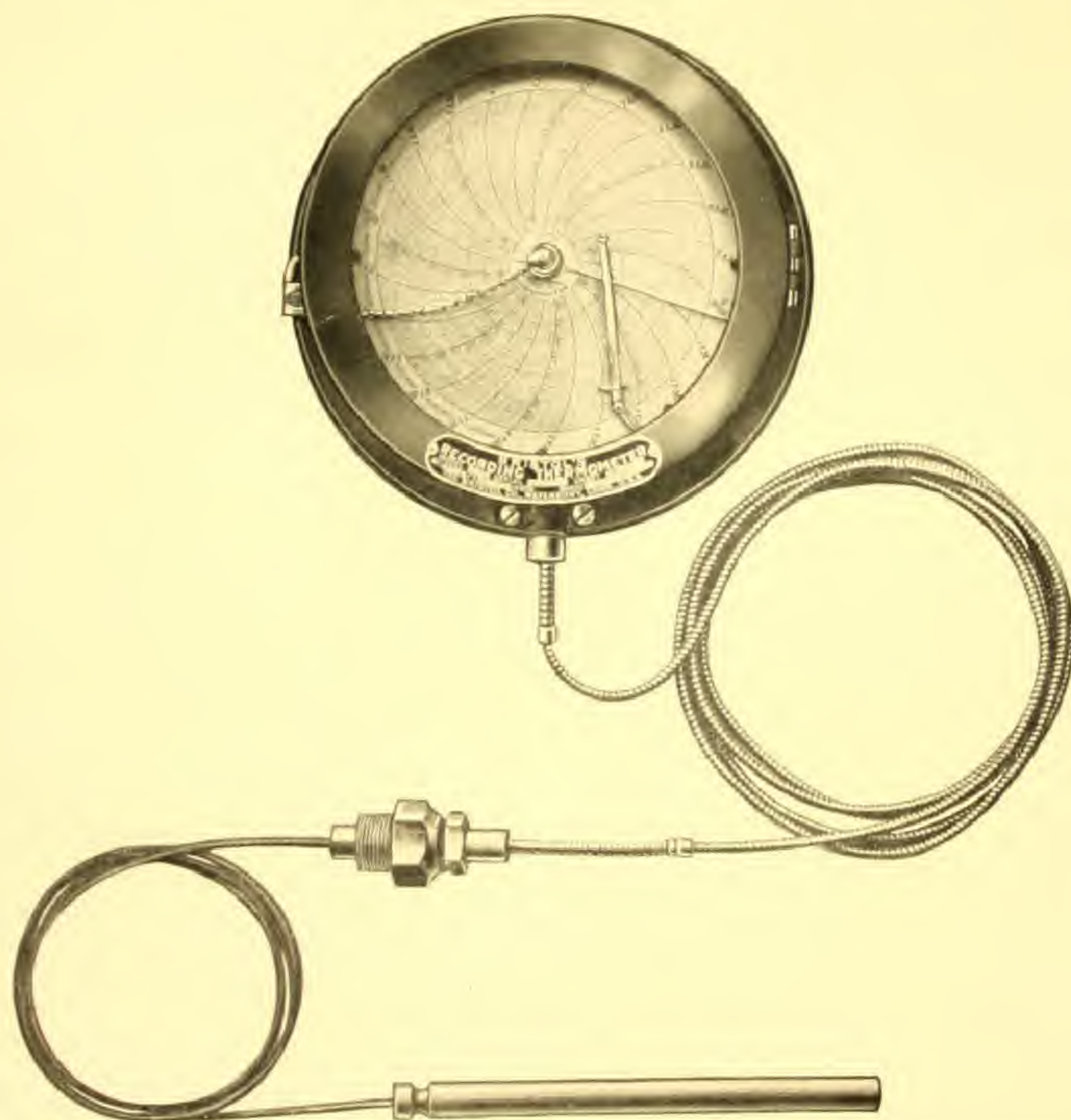
25-feet of flexible connecting tube is the standard length, but may be varied to suit individual requirements.

For selection of bulbs and fittings see pages 22 to 32.



## Round Recording Thermometer With Moisture-Proof and Dust-Proof Case

BRISTOL'S RECORDING THERMOMETER  
ROUND MODEL 341



The operating principle in this round model instrument is the same as all the gas filled recording thermometers. However, the interior construction must necessarily be altered to conform to the round form case.

Two sizes are available in this instrument using charts 10-inches and 8-inches in diameter. For selection of charts see pages 46 to 48. These charts are in no wise interchangeable

with any other model shown in this catalog.

The standard finish of the case is black enamel.

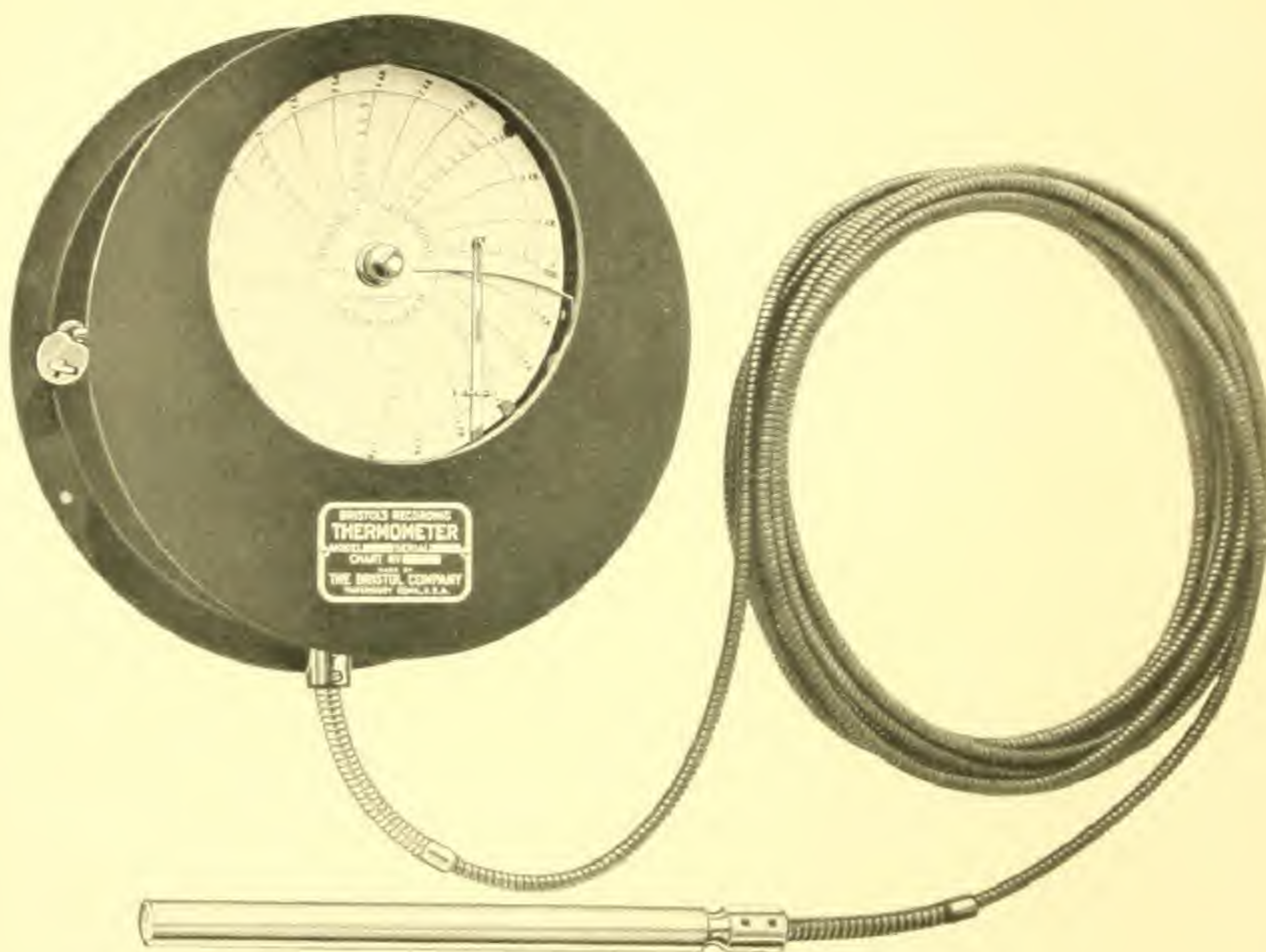
25-feet of flexible connecting tube is standard with this instrument, but may be varied as desired to suit individual conditions.

The same bulbs and fittings for use with the other instruments are used with this round model. See pages 22 to 32 for description.



## A Small Recording Thermometer using Charts 6-inches in Diameter

BRISTOL'S RECORDING THERMOMETER  
MODEL 347



There are many places where it is not necessary to have a close temperature record and where relative temperature only is important. For such places this instrument using 6-inch diameter chart takes care of requirements. It is also lower in price than some of the other models.

The eccentric form case Model 347 permits practically the same angle of deflection for the penarm as in the Models 311 and 340.

Only one size in the model can be furnished. For selection of charts see pages 50 and 51. These charts cannot be used with any other model.

The standard finish of the case is black enamel.

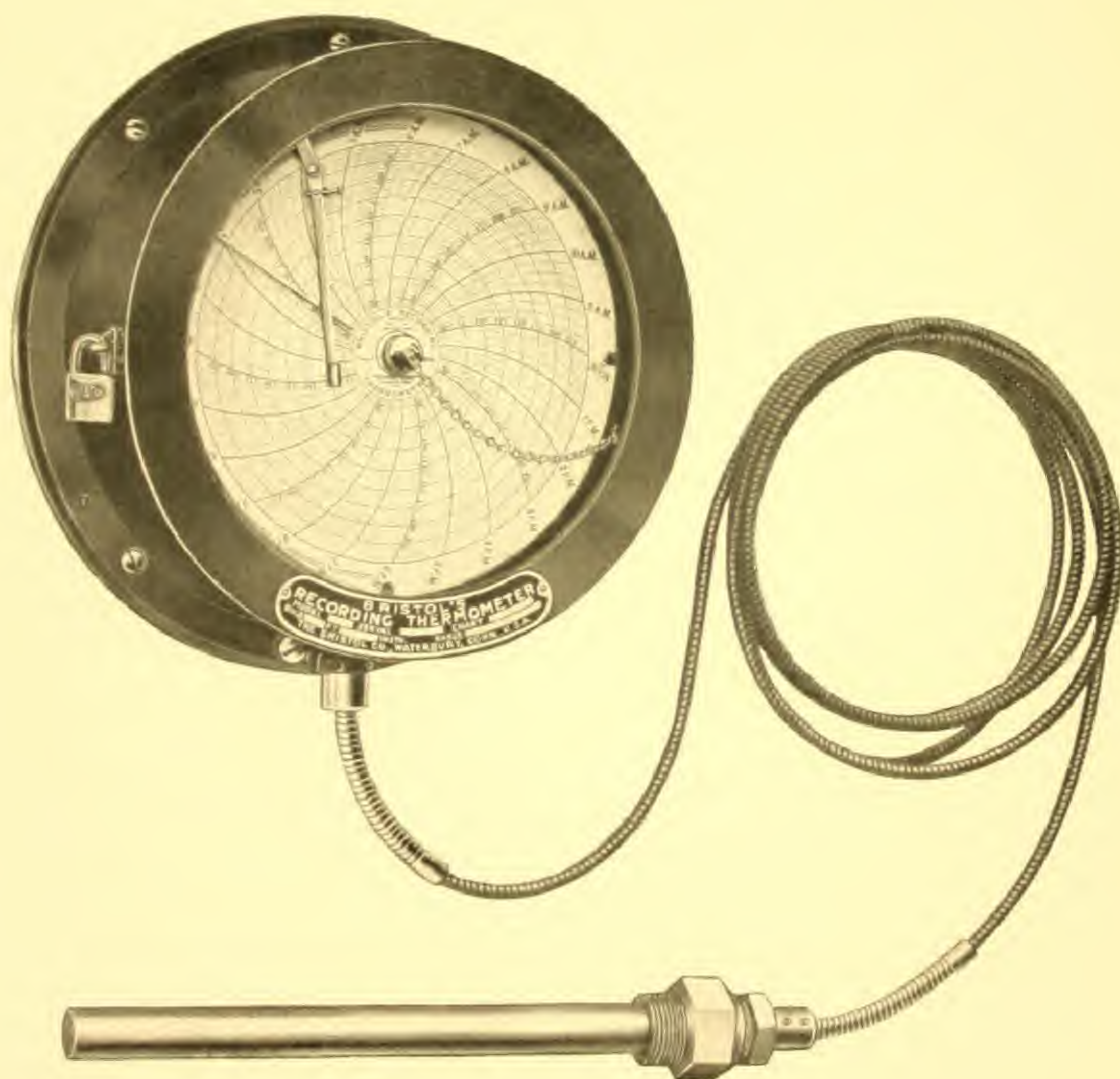
The standard length of connecting tube is 25-feet.

For suitable bulbs and fittings see pages 22 to 32.



## Inverted Penarm

### BRISTOL'S RECORDING THERMOMETER ROUND MODEL, 341 WITH INVERTED PENARM



Differing from the instruments illustrated on the preceding pages, this recording thermometer is equipped with penarm operating from the top. It is called the inverted penarm and for some classes of installations it is preferred.

Any model of Bristol's Gas Filled Recording Thermometers can be furnished with the inverted penarm. The price is the same as with the upright.

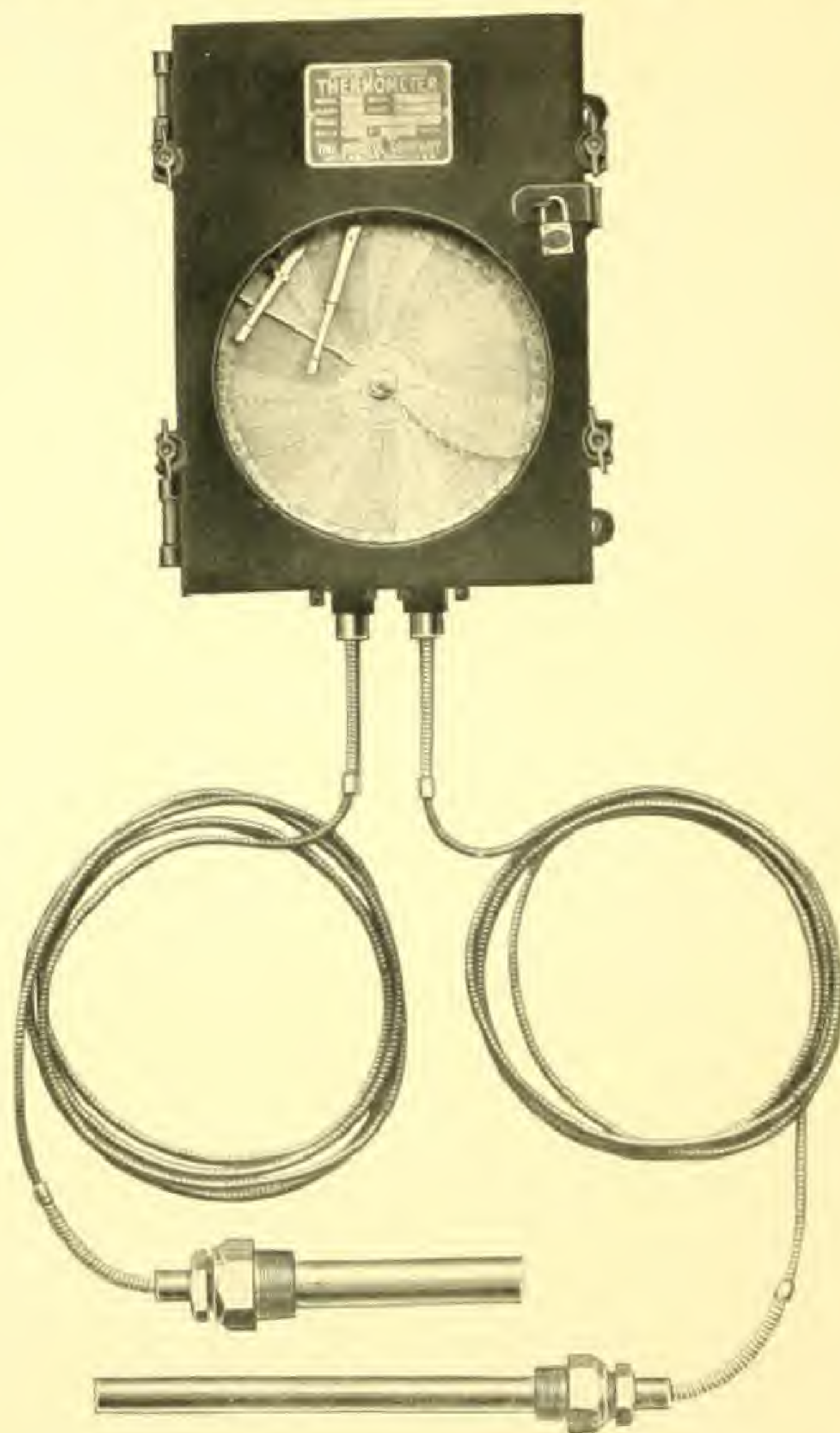
ELECTRICITY

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## Two Records on One Chart

**BRISTOL'S RECORDING THERMOMETER RECTANGULAR MODEL 340  
COMPLETE WITH TWO RECORDING SYSTEMS**



For the purpose of making convenient comparison, it is sometimes desirable to have two temperature records on the same chart. As for example—Economizer Water inlet and outlet; Boiler Flue Gas inlet and outlet.

To provide for the two records on the one chart the Recording Thermometer is equipped with two complete thermometer systems.

The particular instrument shown above is in rectangular moisture-proof case with inverted penarm, but other models can be furnished with two penarms and may be either inverted or upright as desired.

To determine the price of the two-pen recording thermometer, multiply the price list of the single pen instrument by  $1\frac{3}{4}$ .



## Another Two-Pen Recording Thermometer

BRISTOL'S RECORDING THERMOMETER MODEL 311  
INVERTED TYPE WITH TWO PENARMS



This shows another model of Bristol's Recording Thermometer equipped with two penarms and two sensitive bulbs, for recording two different temperatures on the same chart.

In order that there may be no confusion of the two temperature records, usually inks of different colors are used in the pens.

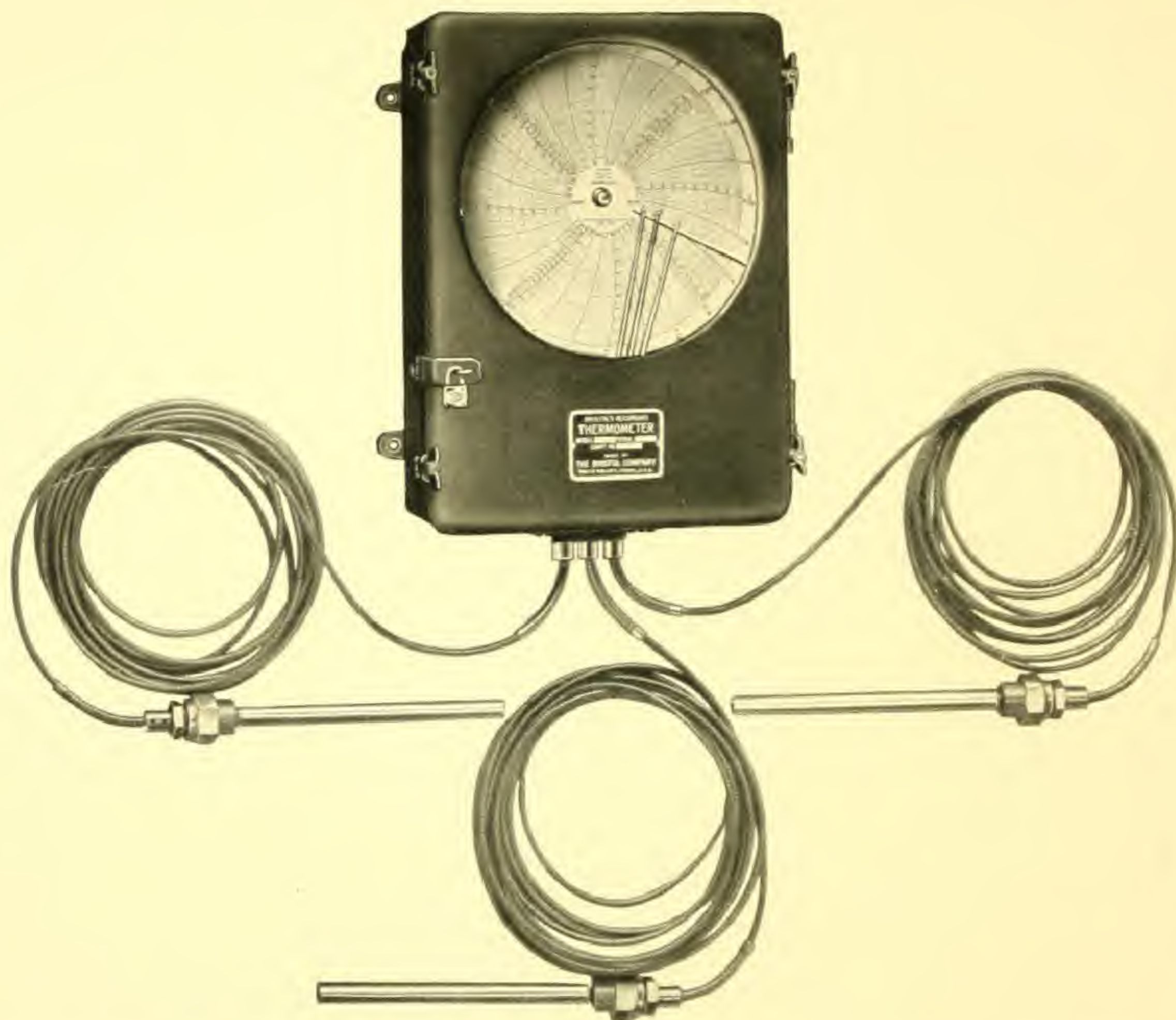
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## Three Records on One Chart

### BRISTOL'S RECORDING THERMOMETER RECTANGULAR MODEL 340 WITH THREE PENARMS



Here is a thermometer with three complete thermometer units mounted in the one case so that they will record on one chart.

Such an equipment is valuable where in order to obtain the greatest efficiency in some processes, it is necessary to know and record the temperatures in three different locations on the same process. It provides an easy method of comparison and simplifies the filing of such records.

As an example of where such installations are used, Flue Gas Economizer with records

of, (1) Flue Gas leaving Boiler, (2) Flue Gas leaving Economizer, (3) At Air Preheater. Also, (1) For heating Steam, (2) Feed Water, (3) Air Temperature.

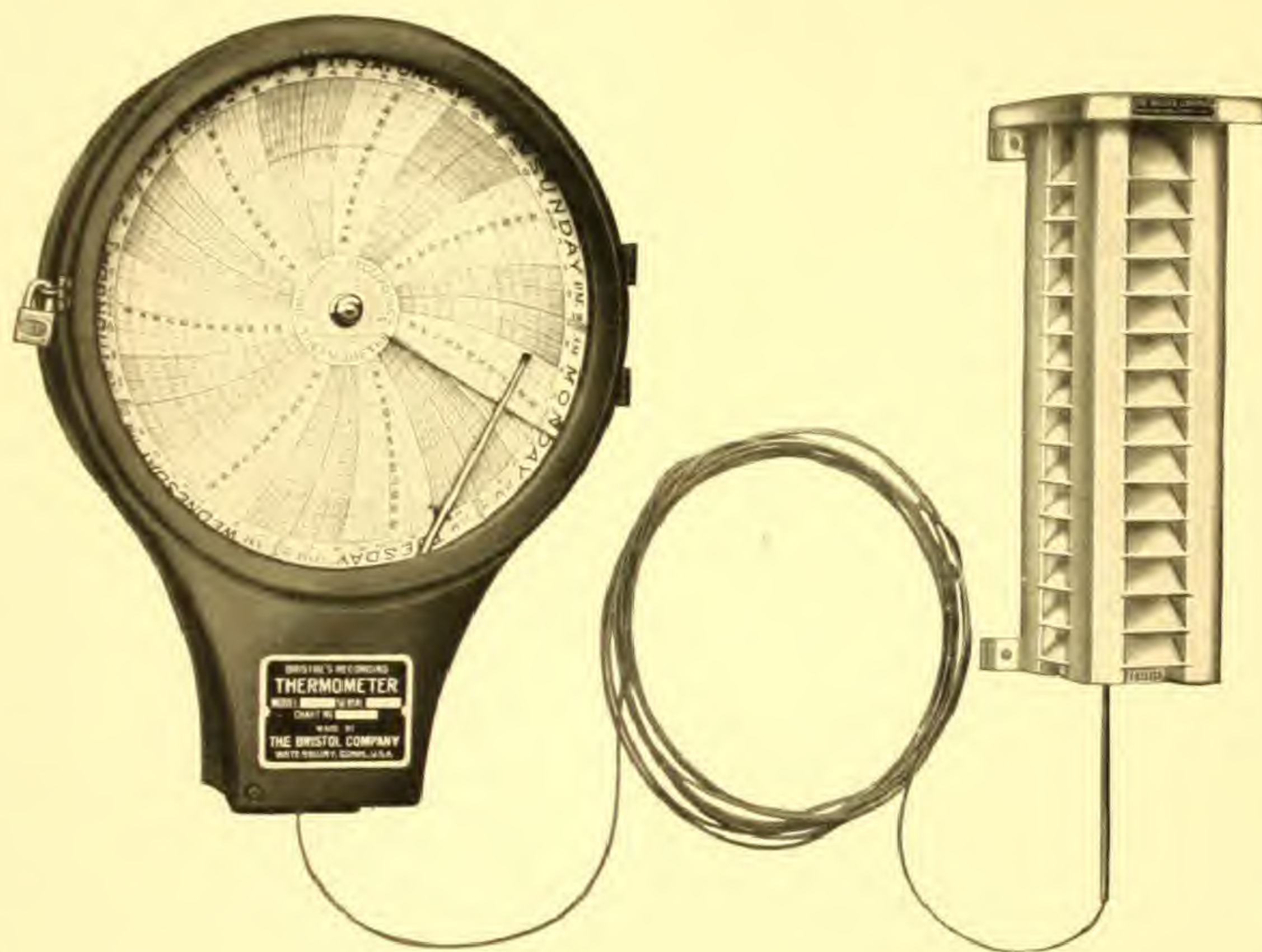
There are many other such groups where a three-pen Bristol's Recording Thermometer furnishes valuable information.

To determine the price of Bristol's Three-Record Recording Thermometers, multiply the list price for single penarm by  $2\frac{1}{2}$ .



## Outdoor Atmospheric Temperatures Recorded Indoors

BRISTOL'S RECORDING THERMOMETER MODEL 311  
COMPLETE WITH WEATHER HOUSE



Here is a recording thermometer outfit for recording outdoor atmospheric temperatures. It is so arranged that the instrument with the chart can be located inside the building, while the sensitive bulb is mounted outside in the latticed weather house, where it is exposed to the outside atmospheric temperatures.

By being able to observe the actual temperature changes, it is possible to anticipate the demands upon heating and cooling

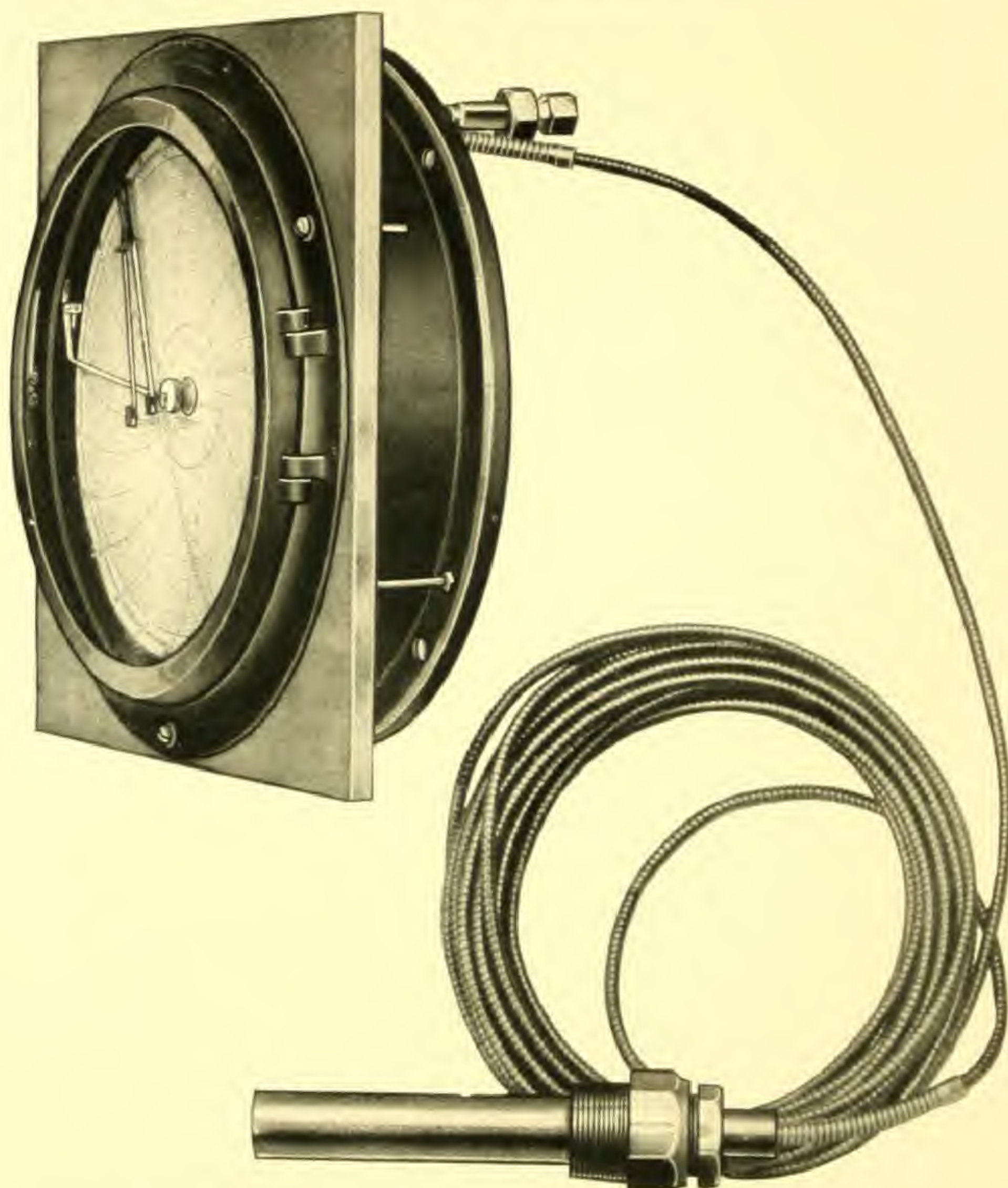
systems, with the result that much greater economy and efficiency is obtained. For these reasons this type of recording thermometer is extensively used by hotels, apartment houses, manufacturing plants, public buildings and in private residences.

A similar equipment can be furnished with two pens so that the second pen records the indoor room temperatures.



## Flush Type Model for Panel-Boards

### RECORDING THERMOMETER FLUSH TYPE MODEL 343



The thermometer is especially suited for mounting on panel-boards. It is equipped with a separable rim so that it can be mounted flush with all the connections made at the back. This arrangement gives a very neat appearance.

The particular instrument illustrated is equipped with two pens, one for recording temperature and the other pressure. Such an instrument would be used for recording pressure and temperature of Steam in Main Steam

Header, also water pressure and temperature in Main Boiler Feed Leader, etc.

This same model of instrument can be furnished with one or two pens for recording temperature alone.

Charts 10-inches or 8-inches in diameter can be furnished with this model. See list of temperature charts on pages 46 to 48.

The standard finish for case is black enamel.



## Wooden Protection Case

### TO SHIELD THE INSTRUMENT FROM DUST, DIRT AND MECHANICAL INJURIES



When this Model 311 Recording Thermometer is to be used in locations where it will be subjected to excessive dust and dirt, the additional wooden protection case should also be used.

The case is made of wood with varnished finish, and equipped with lock and key which

prevents unauthorized persons from tampering with the recording instrument. However, the glass door enables the attendant to observe the chart record without difficulty.

This protection case is made in two sizes suitable for instruments with 12-inch charts and 8-inch charts.

#### LIST PRICES

12-inch size	\$18.75
8-inch size	16.50



## Alarm Bell, Signal Horn, or Lights Automatically Operated by Recording Thermometer



The failure to know when temperatures go too high or too low often means spoiled work. Usually the man in charge has many duties to perform, some of these take him a distance away. For just such conditions Bristol's Recording Thermometers can be equipped with an electric contact device to automatically sound an alarm. This warns the attendant of critical temperatures or the approaching danger point.

The electric contact device is located in the instrument back of the dial. In all models except the round form, it is adjustable for two points within the scale range, so that the alarm will be sounded for both high and low.

In the round cases, however, only one contact is possible.

Dry cell batteries or lighting circuit may be used to operate the alarm. It may be an ordinary electric alarm bell or where there are two contacts, bells of different tones can be supplied to differentiate between high and low. Also signal horns may be operated in the same way, or if desired, relays can be furnished to operate colored lights instead of the usual alarm.

Bristol's Recording Thermometers already in the field can be returned to the factory to be equipped with the alarm device.

List Prices for Alarm Attachment with  
Bell and Dry Cell Batteries as shown above,  
\$25.00. For other alarm systems prices quoted.



## Automatic Temperature Control

### BRISTOL'S TEMPERATURE CONTROLLER MODEL 377



Mechanical automatic control of temperature is the ideal. This is now very extensively being accomplished with Bristol's Thermostats in connection with furnaces, ovens and other heat treating equipment, using gas, oil or electricity.

Model 377 Thermostat shown above operates on the same principle as the gas filled recording thermometer. It is actually an Indicating Thermometer used to operate an electrically controlled valve which regulates the fuel supply.

The outstanding benefits of automatic temperature control are:

1. Uniform product of better quality.
2. Increased production.
3. Decrease in repairs on equipment.
4. No waste in fuel.

For automatic control of temperatures higher than is possible with the Thermometer Thermostat, a similar equipment operated on the thermo-electric principle can be furnished for temperatures up to 3000°F.

Details and prices furnished on request.



## Flexible Connecting Tube and Protections

To connect the sensitive bulb with the recording instrument, a flexible capillary tubing is used. This allows the bulb to be installed in the most convenient place (often almost inaccessible) and the instrument located on a panel-board or wall, where it may be observed.

As explained under the subject of bulbs on page 22, the working system is filled with a gas, and any break would cause the gas to escape, with the result that the instrument is useless and must be returned to the laboratory to be repaired. For this reason, the capillary tubing is encased in an additional flexible covering. This covering may be one of several different materials to suit individual requirements. (1) Plain Metal Armor of bendable Copper, Lead or Steel, (2) Flexible Armor of Bronze, Steel or Monel, (3) Double Flexible Armor of Bronze or Steel, (4) Any Flexible Armor of Steel, Bronze or Monel can be covered with Friction Tape. This latter is rarely used except where there is excessive dampness or corrosive fumes, which will penetrate even the efficient armored covering.

The standard length of connecting tube is 25-feet, but may be varied as required, to suit individual cases. With the gas filled type of thermometer, connecting tube longer than 300-feet is not usually recommended. When it is required to locate the thermometer more than 300-feet away from the sensitive bulb, Bristol's Long Distance Electric Transmitting System described on opposite page is available and recommended.

### PLAIN ARMOR of Bendable Copper, Lead or Steel



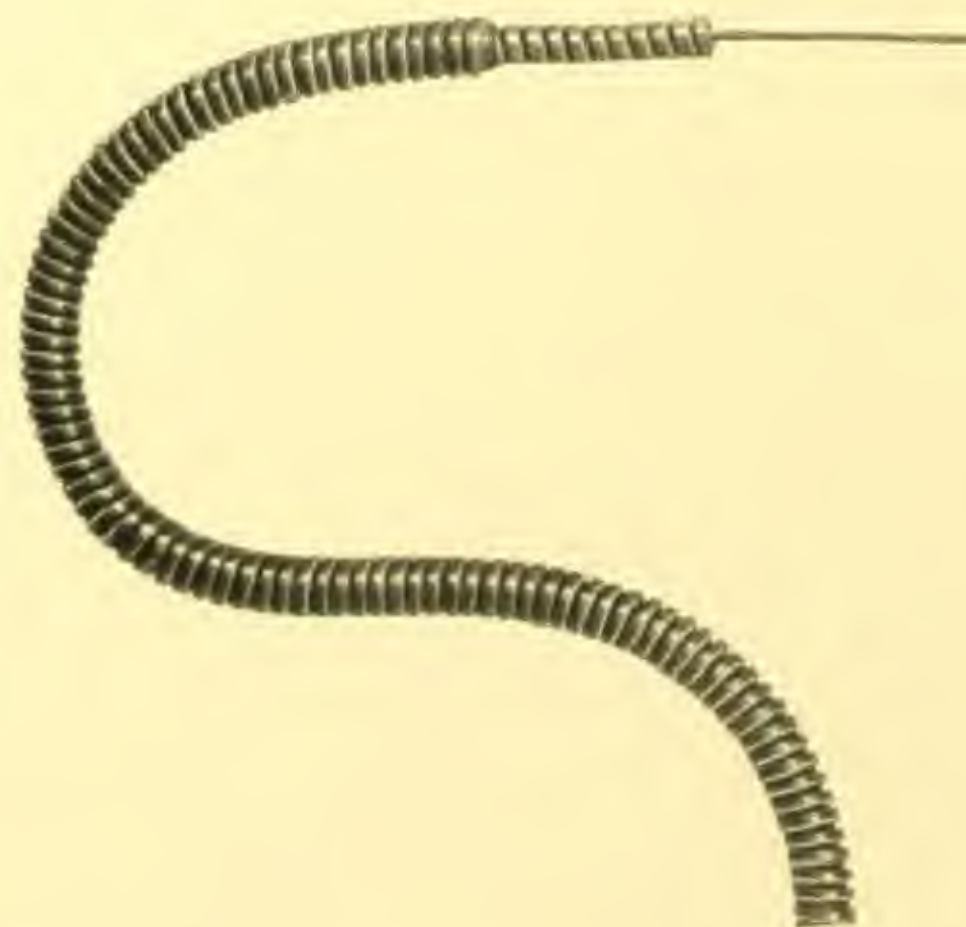
In some places where moisture or acid fumes would penetrate the flexible protection, or even where it is necessary to install the tubing through tanks containing liquid, this seamless annealed armor can be used. It is moisture-proof, water-proof and pressure tight. It is preferably recommended for permanent installations where frequent handling is not necessary, for although it is a bendable armor, cannot be classified as flexible.

### FLEXIBLE ARMOR of Bronze, Steel or Monel



This illustration shows the small capillary tube used between the sensitive bulb and recording instrument, together with the flexible armor protection, which may be supplied in bronze, steel or monel. This furnishes ample mechanical protection for the capillary tube except for unusual conditions.

### DOUBLE FLEXIBLE ARMOR of Bronze or Steel

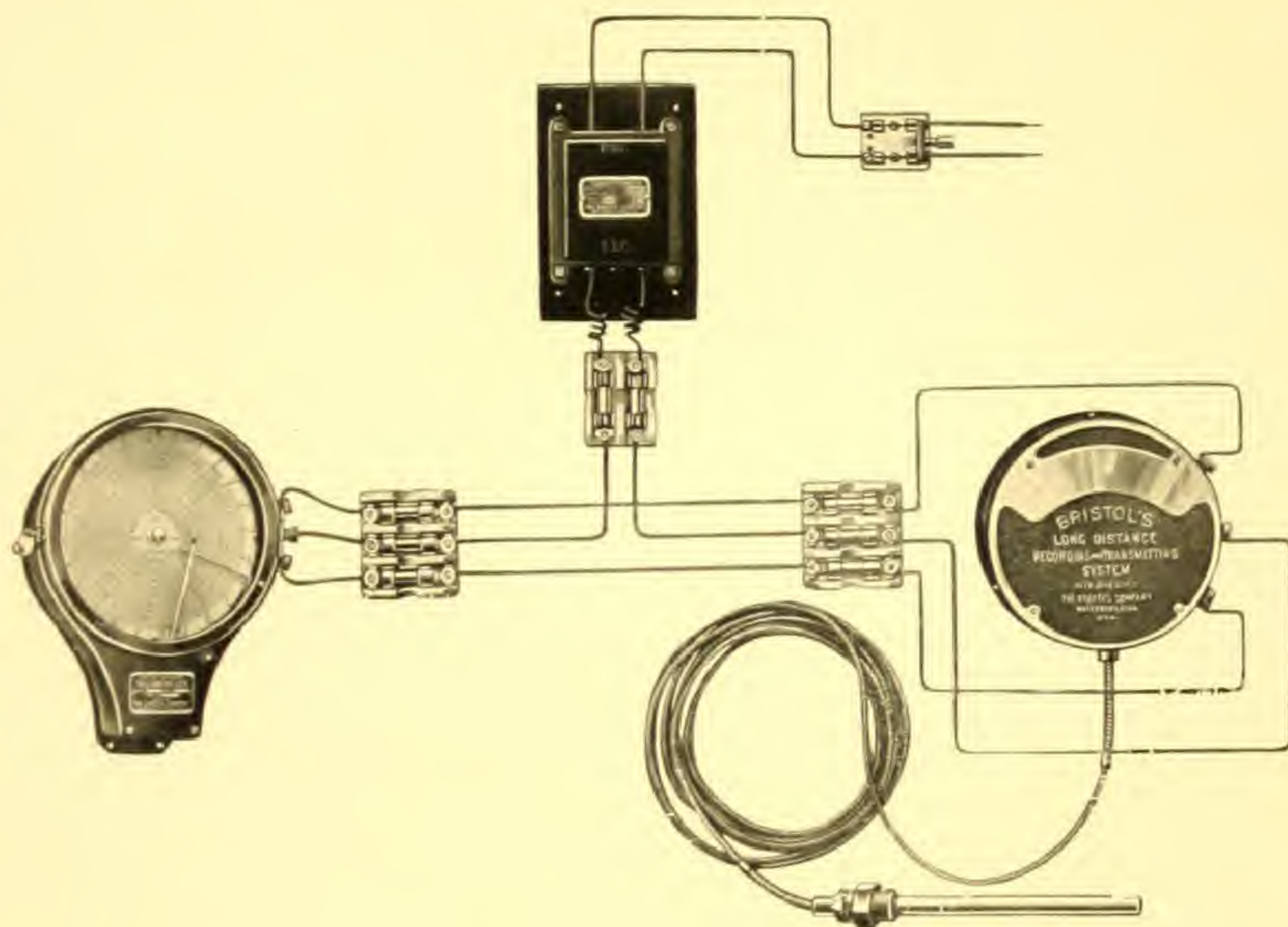


Where greater protection is needed than already provided by the single armor, an additional flexible armor of bronze or steel can be furnished, as shown above.



## Thermometer Records Transmitted Over Distance of Even Several Miles

### BRISTOL'S LONG DISTANCE ELECTRIC TRANSMITTING SYSTEM



In big plants it is often desirable to segregate all the recording instruments for the purpose of central control. For such requirements Bristol's Long Distance Electric Transmitting and Recording System is recommended. It is practical for distances of even several miles, while the Recording Thermometers with flexible capillary tubing shown in this catalog are not recommended for distances greater than 300-feet.

This Long Distance Electric Transmitting System operates on the induction balance principle. It is a 3-wire system and uses alternating current, but can also be arranged for D. C.

Not a complicated equipment, but can be installed by your own men. Neither is it so fragile as to require constant fine adjustments. On the contrary, it is rugged and demands very little attention.

Not only records of temperature are transmitted with this system, but it is also extensively used in connection with liquid level, pressure and mechanical motion in connection with Hydro-Electric Systems, Central Heating Stations, etc.

Detailed description and prices furnished on request.



## Sensitive Bulbs Used With Recording Thermometer

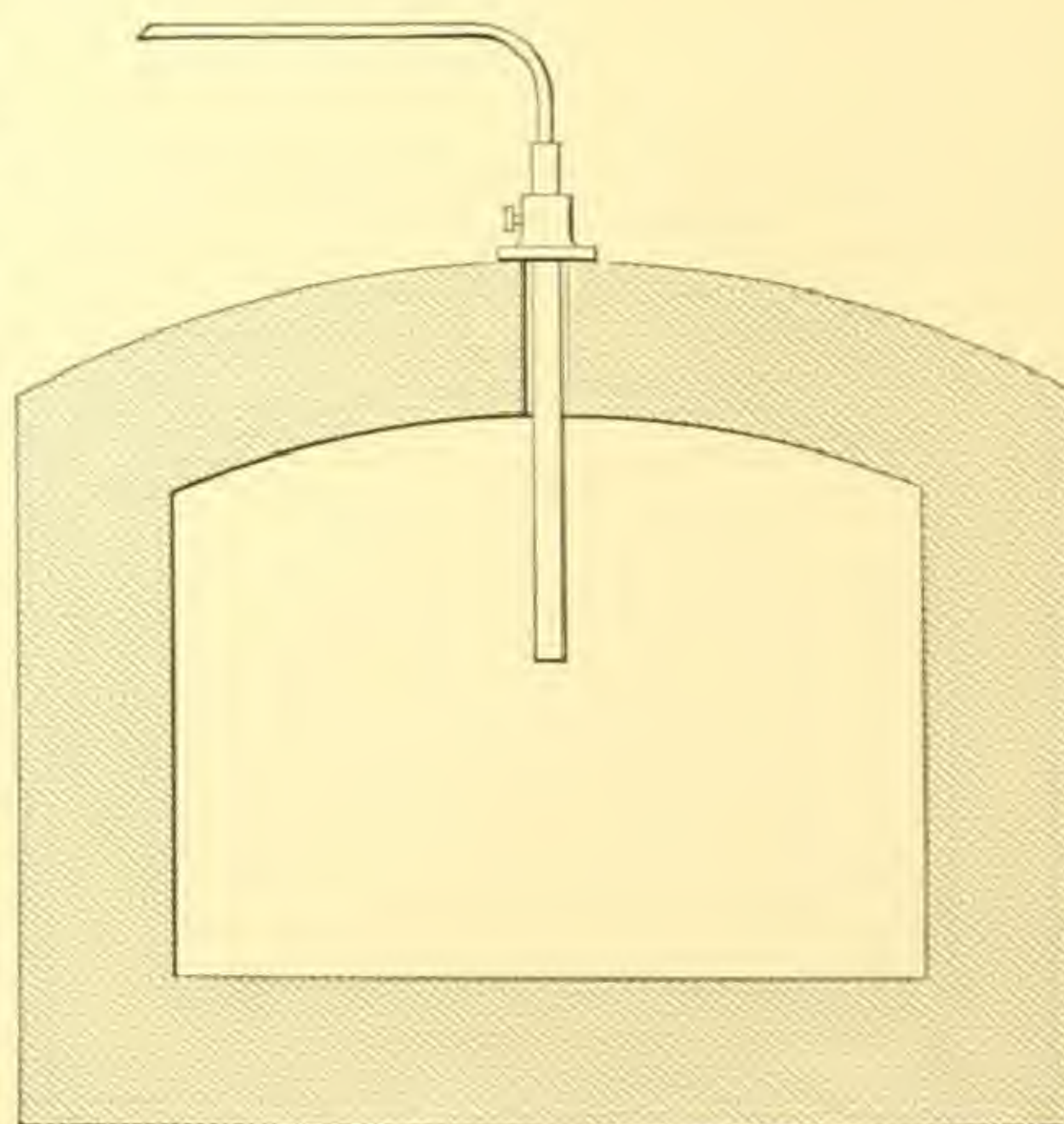
The Bulb, is that part of the recording thermometer equipment which is installed directly in the medium, of which the temperature is to be measured.

The expansion of a gas is used to operate the recording thermometers described in this catalog. Nitrogen gas is used, and the systems are filled under pressure and sealed. Thus, it is important that the bulbs and flexible connecting tube be adequately protected from mechanical injury or corrosive action. A break in the system will cause the gas to leak out and make the thermometer inoperative.

The great variety of uses for recording thermometers in the industries makes it necessary to supply bulbs suitable for the various operations. For more than thirty-five years The Bristol Company has been making recording thermometers. During this time they have specified thermometers for thousands of applications, and in each instance where bulbs have been required to meet a new need, they have been designed. This accumulation places them in a position to take care of practically any kind of requirement. A partial list only of these bulbs for gas filled recording thermometers will be found on pages 24 to 32.

In selecting bulbs, thought must be given not only as to whether it will fit into the space available, but also in regard to the actual material as affected by any chemicals with which it may come in contact. As an example, in ammonia lines a copper bulb should not be used, but instead steel. In rubber vulcanizers where sulphur is present, copper bulbs with lead covering are used, because lead protects from the action of the sulphur. With these facts in mind, Bristol's bulbs have been developed to take care of practically all applications ever encountered, and can be furnished in copper, bronze, brass, steel, cast iron and monel, also nickel plated, silver plated, gold plated, tinned, lead covered, etc.

The bulbs listed fall into four general classifications: (1) Plain Bulbs for use in open spaces for securing atmospheric temperatures in ovens, kilns, etc. (2) Bulbs with Pipe Thread Connection used in closed spaces such as pipe lines, tanks and vats. (3) Bulbs with Separable Sockets so arranged that the socket is permanently installed and allows the bulb itself to be removed as desired. (4) Bulbs which are used on specialized applications such as pulp digesters, milk pasteurizers, tanks, etc.

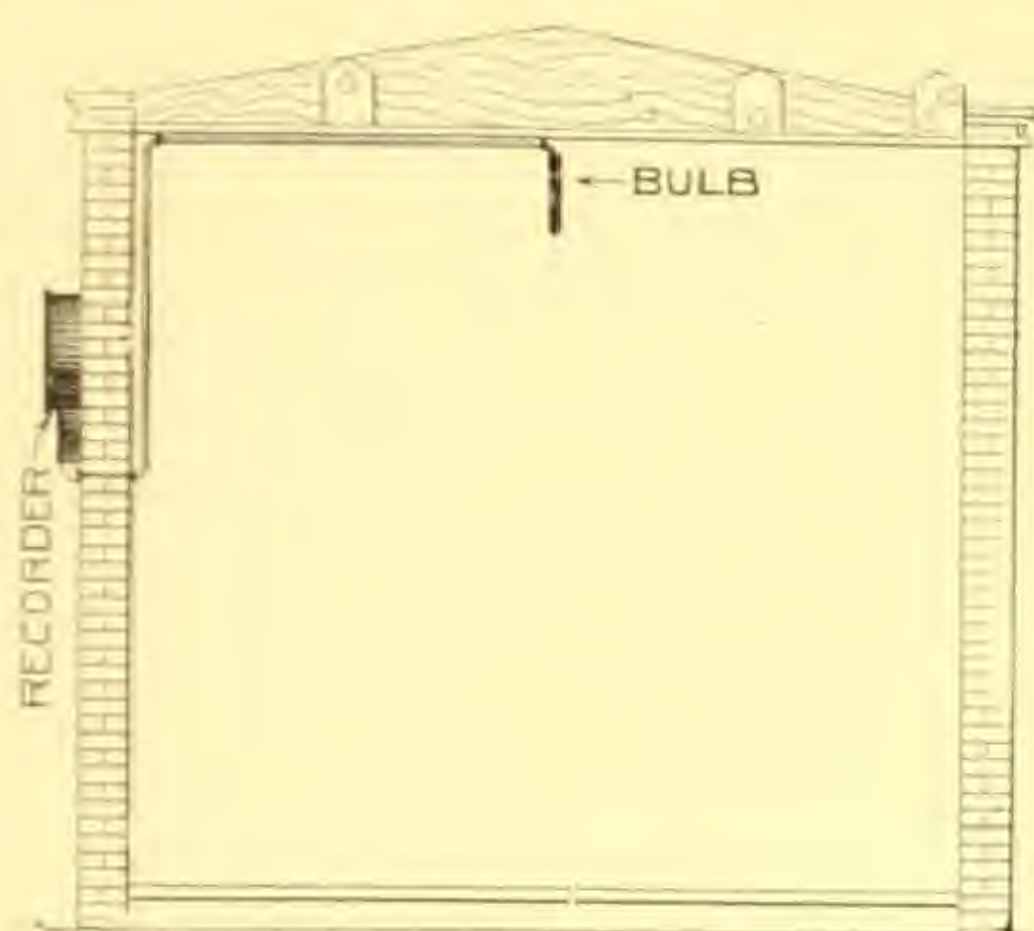


**PLAIN BULB**  
**APPLIED IN VERTICAL POSITION**

This illustrates bulb installed through wall and supported by an adjustable flange or collar. It is for use in open spaces such as flues, tanks, ovens, etc.

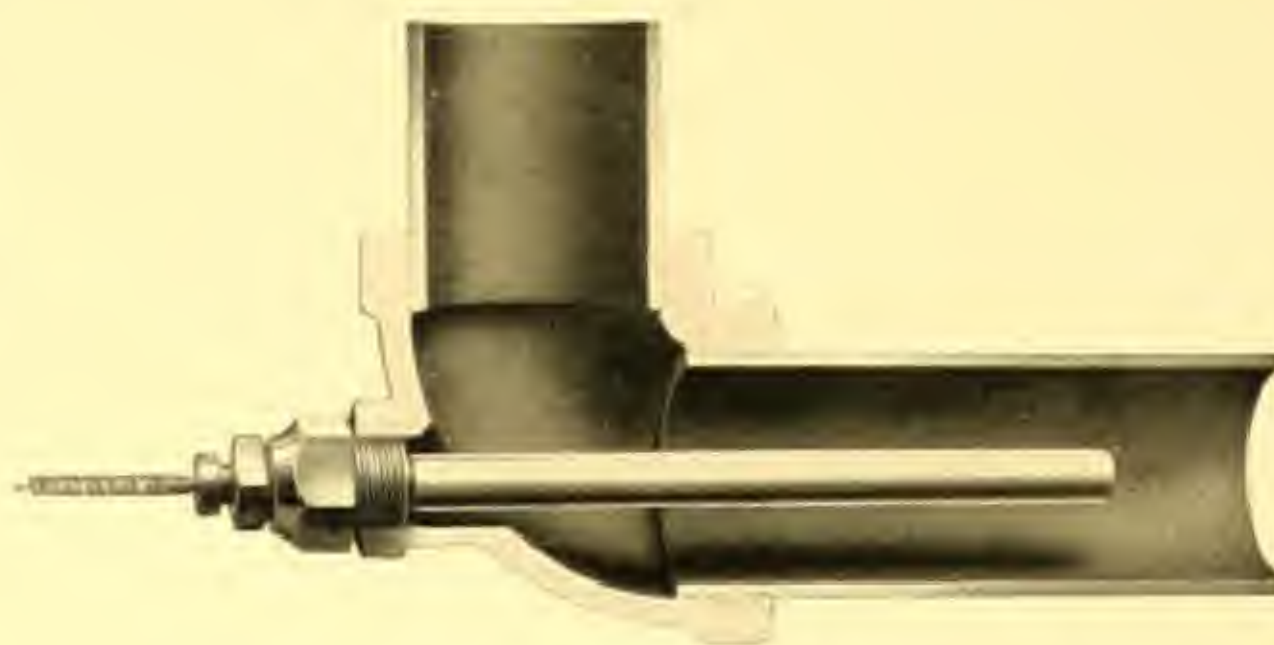


## Sensitive Bulb Used With Recording Thermometer



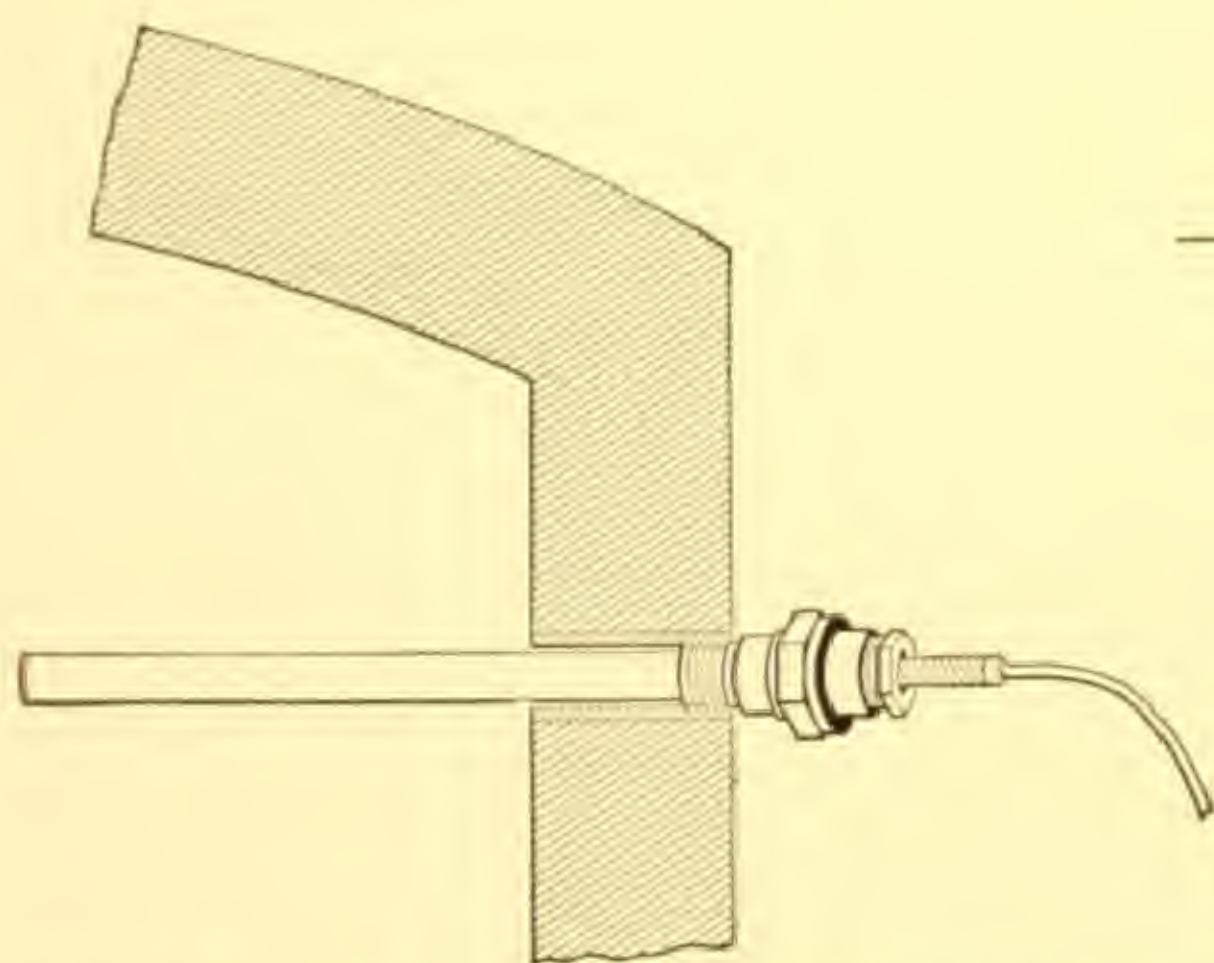
### PLAIN BULB IN OPEN SPACES

Here the connecting tube is carried through the wall and bulb suspended from the top. It is often used this way in connection with dry kilns, ovens and other similar places.



### BULB WITH PIPE THREAD INSTALLED AT ELBOW OR TEE

In pipes and mains where the bulb is to be subjected to temperatures of liquids, steam, gas, or air under pressure, the installation at an elbow or tee is the ideal. Such a position gives ample room for the bulb and allows a free circulation of the medium around the sensitive portion.



### BULB WITH PIPE THREAD CONNECTION APPLIED IN HORIZONTAL POSITION

This bulb with pipe thread connection is used where the pipe thread is desired for holding the bulb securely in a horizontal position, or where a pressure-tight connection is required in closed spaces.



### CROSS SECTION OF BULB WITH SEPARABLE SOCKET

This clearly shows the bulb in relation to the separable socket. Such a fitting is used where it is desired to install the socket permanently, and the bulb can be removed or inserted at will.

Bulbs listed in this catalog give dimensions to be used with 25-feet, which is the standard length of connecting tube. If, however, longer lengths are required to be used with instruments having a total range of less than 400°F., it is necessary to increase the volume of the bulb, and this is usually accomplished by increasing the length. Under such conditions the standard dimensions do not apply.

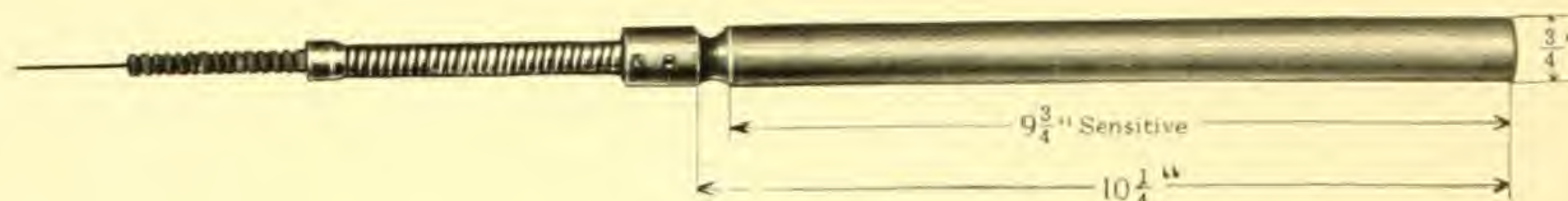


## Plain Bulbs

### FOR USE WITH GAS FILLED RECORDING THERMOMETERS

#### No. 302—COPPER BULB

(Reinforced Flexible Bronze-Armored Connecting Tube)



Used for suspending in tanks and vats containing liquids; also for temperatures of air in open spaces such as ovens, kilns, ducts, etc., including Ice Cream Hardening Rooms, Brine Tanks, Steel Tempering Vats, Dry Kilns (Lumber,) Core Ovens, Japan Ovens,

Paint Baking Ovens, Smoke Houses, Dry Curing Ovens in Rubber Plants, Incubators. When required for temperatures above 800°F., this bulb can be furnished made of welded steel at a small additional cost.

#### No. 2302—COPPER BULB

(Reinforced Flexible Bronze-Armored Connecting Tube)

This bulb is similar to No. 302, the difference is in dimensions. It is  $5\frac{1}{2}$ -inches long and 1-inch diameter and intended for

use where it is not practical to install the longer Bulb No. 302.

#### No. 312—COPPER BULB WITH BRASS RADIATING DISCS

(Reinforced Flexible Bronze-Armored Connecting Tube)



Similar to No. 302, but equipped with brass radiating discs which gives added sensitivity.

Particularly suitable for atmospheric tem-

peratures in open spaces for Out-of-Doors, Smoke Houses, Japan Ovens, Paint Baking Ovens, Paint Drying Ovens, Generator Ventilating Ducts.

The bulb dimensions given on this page are for 25-feet (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.

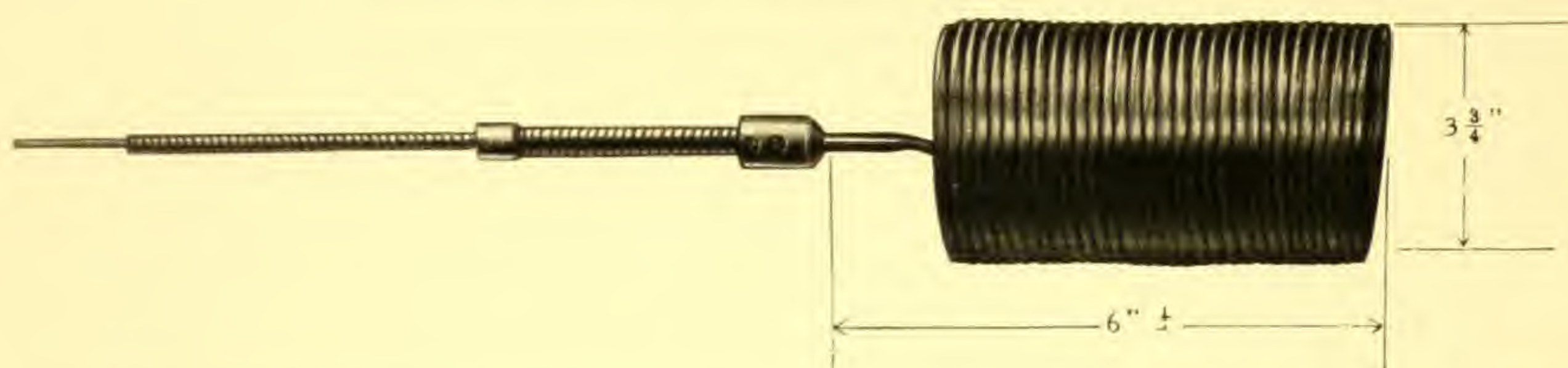


## Plain Bulbs

### FOR USE WITH GAS FILLED RECORDING THERMOMETERS

#### No. 3312—PLAIN COILED COPPER BULB

(Reinforced Flexible Bronze-Armored Connecting Tube)



Made of  $\frac{3}{16}$ " diameter bendable copper tubing and coiled, but when uncoiled is 25-feet long. Where there are gases present which attack copper or for use with temperature above 800°F., this bulb can be furnished made of steel at a small additional charge.

This long, bendable bulb is intended for securing average temperatures in large ovens and flues, including applications such as Core Ovens, Japan Ovens, Paint Baking Ovens, Food Baking Ovens, Flue Gases, Etc.

#### No. 362—BULB WITH WROUGHT IRON PIPE COVERING

(Reinforced Flexible Bronze-Armored Connecting Tube)



The wrought iron pipe gives extra protection and mechanical strength. Although it is an additional covering it is a part of the bulb construction and cannot be removed.

This long bulb is particularly adapted to insert through thick walls, as usually required in connection with recording Flue Gas Temperature. It is not, however, recommended for temperatures lower than 400°F.

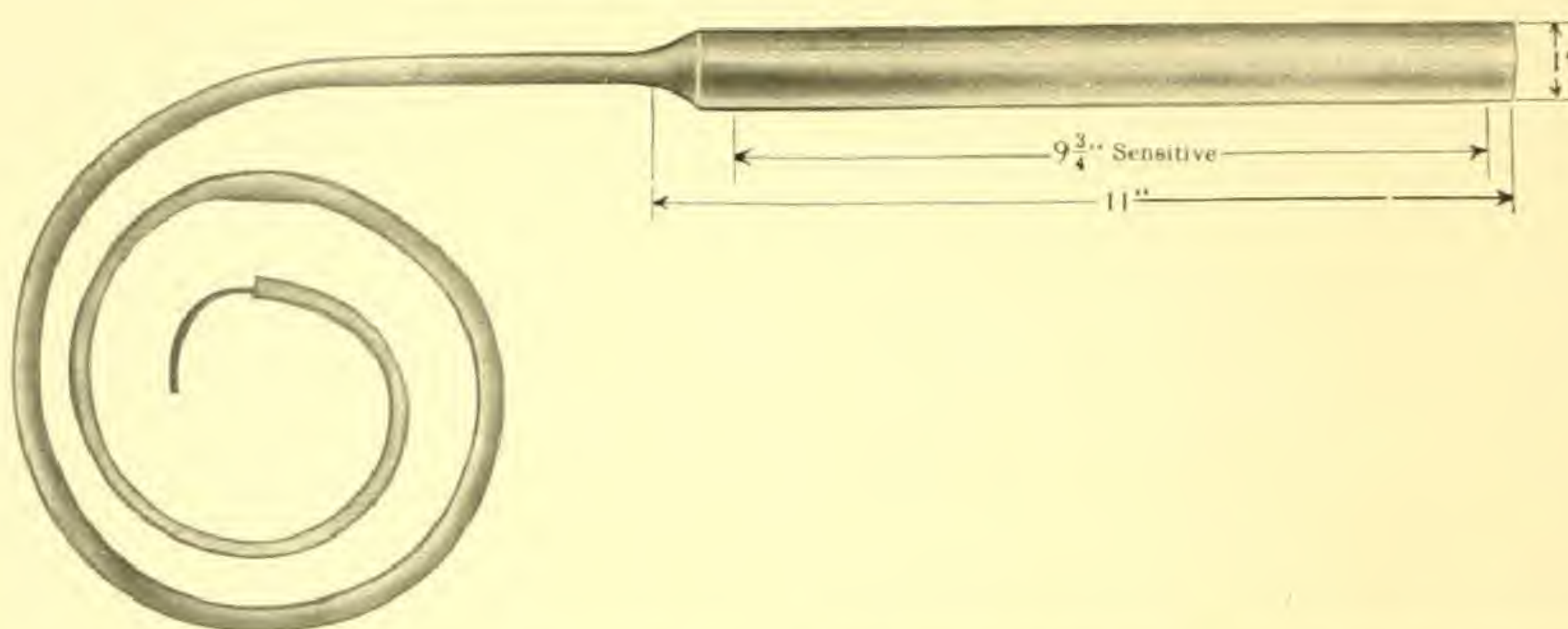
The bulb dimensions given on this page are for 25-foot (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.



## Plain Bulbs

### FOR USE WITH GAS FILLED RECORDING THERMOMETERS

#### No. 304—LEAD COVERED BULB (Reinforced Lead-Covered Connecting Tube)



The lead covering adapts this bulb for uses where plain copper would be injured by certain liquid chemicals and fumes. In selecting this Lead Covered Bulb, it should be kept in mind that the melting point of pure lead is approximately 600°F., and should not

be specified for use where it will be subjected to higher temperatures.

Used for suspending in tanks and vats containing liquids; also in open spaces such as ovens, kilns and ducts. As examples—Pickling Vats for Steel, Pulp Bleachers in Pulp Mills, Dry Vulcanizers for Rubber.

#### No. 0304—LEAD COVERED BULB (Reinforced Lead-Covered Connecting Tube)

Similar to No. 304 except for dimensions. It is 6 1/4-inches long and 1 1/4-inch diameter.

Used where there is not room for the longer bulb.

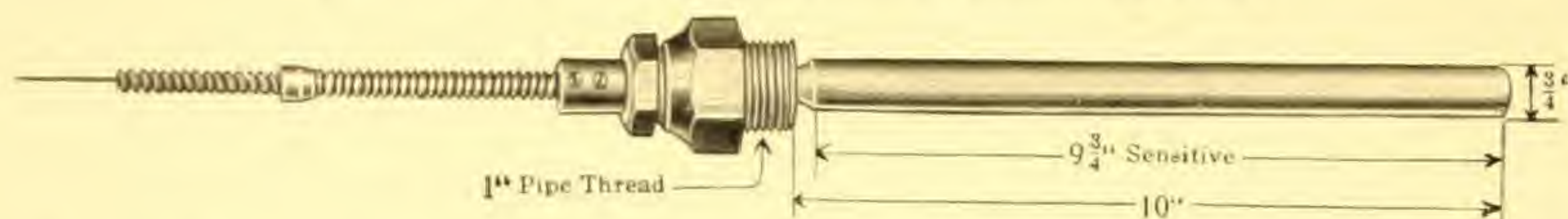
The bulb dimensions given on this page are for 25-foot (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.



## Bulbs With Pipe Thread Connection FOR USE WITH GAS FILLED RECORDING THERMOMETERS

### No. 322—COPPER BULB

(Reinforced Flexible Bronze-Armored Connecting Tube)



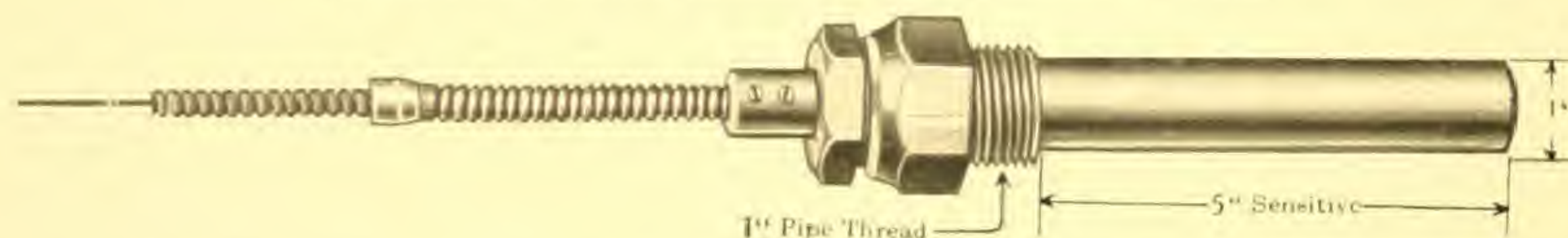
Threaded connection insures a tight joint when used with Vats, Tanks, etc., under pressure.

A few specific applications are—Feed Water Lines and Heaters, Hot Water Lines

and Heaters, Cold Water Line, Fuel Oil Line, Artificial Gas at Main Heater, Blast Furnace in Clear Gas Main, Water Before and After Gas Scrubbers, Bosch Water, Cold Blast Temperatures, Etc.

### No. 327—COPPER BULB

(Reinforced Flexible Bronze-Armored Connecting Tube)



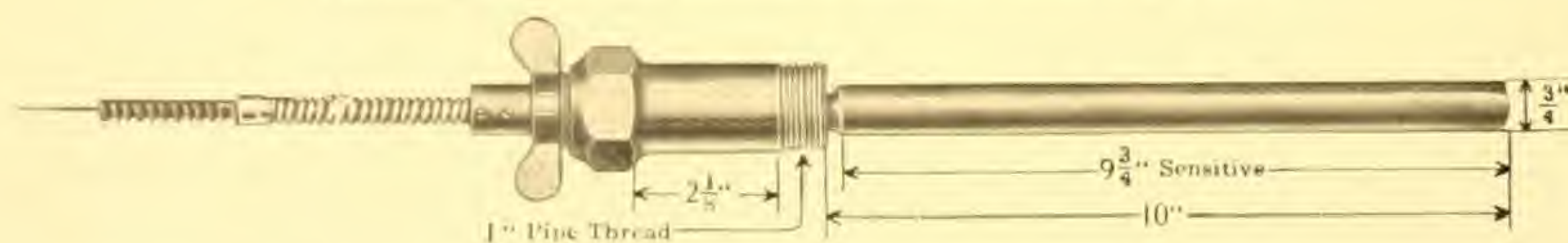
Similar to No. 322 except for dimensions which are shorter in length and greater diameter. It is for use in such places where

there is not sufficient room for the longer bulb.

The same general applications apply for this bulb as for No. 322.

### No. 1392—COPPER BULB WITH EXTENSION FOR LAGGING

(Reinforced Flexible Bronze-Armored Connecting Tube)



Same as No. 322 except provided with extension for lagging. Extension adapts the bulb for use where there is an extra thick wall,

additional layer of insulation, etc. Otherwise the applications are practically the same as for 322.

The bulb dimensions given on this page are for 25-feet (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.

ELECTRICITY

ELECTRICITY

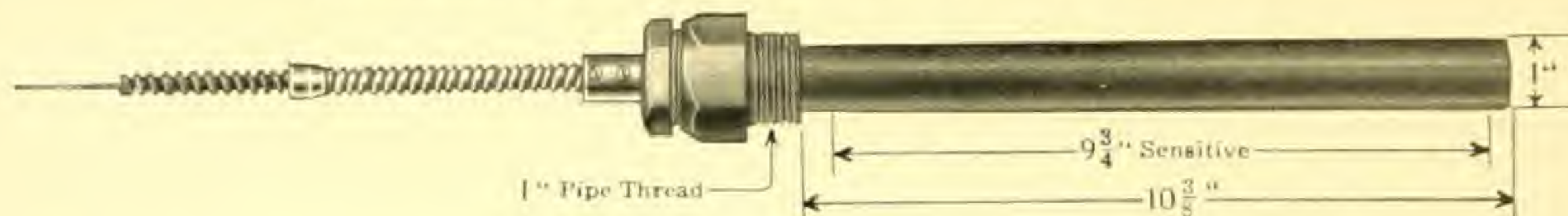
MOTION, ETC.



## Bulbs With Pipe Thread Connections

### FOR USE WITH GAS FILLED RECORDING THERMOMETERS

#### No. 352—LEAD COVERED BULB (Reinforced Flexible Bronze-Armored Connecting Tube)

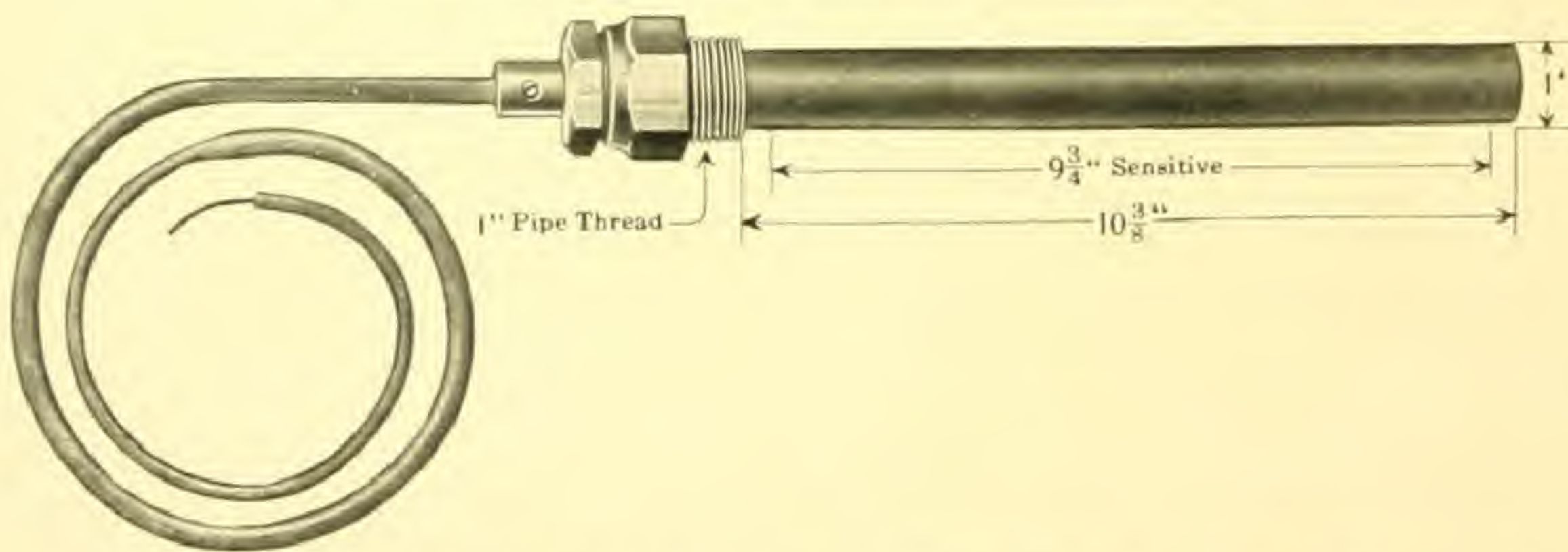


The lead covering protects the bulb from chemical action of certain acids. The standard pipe connection is made of brass but can be furnished made of steel when it will be used near acids which attack brass.

The melting point of pure lead is approximately 600°F., therefore, this bulb should not be specified where it will come in contact with higher temperatures.

This bulb is used in connection with Acid Lines and Tanks, Rubber Vulcanizers, etc.

#### No. 353—LEAD COVERED BULB (Reinforced Flexible Lead-Covered Connecting Tube)



Exactly like No. 352 already described, except that the flexible connecting tube is also lead covered.

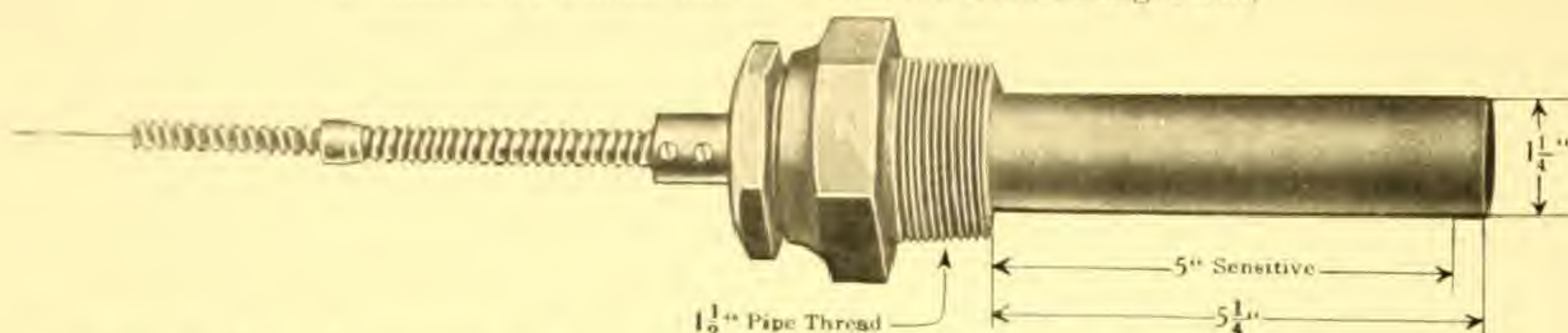
The standard pipe thread connections for this bulb is brass but can be furnished made of steel when it will be used near acids which attack brass.

The bulb dimensions given on this page are for 25-foot (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.



## Bulbs With Pipe Thread Connections FOR USE WITH GAS FILLED RECORDING THERMOMETERS

### No. 357—LEAD COVERED BULB (Reinforced Flexible Bronze-Armored Connecting Tube)



Similar to No. 352 except for dimensions which are shorter in length and greater in diameter. It is for use in such places where there is not sufficient room for the longer bulb.

The same general applications apply for

this bulb as for No. 352.

The standard pipe thread connection for this bulb is brass but can be furnished made of steel when it will be used near acids which attack brass.

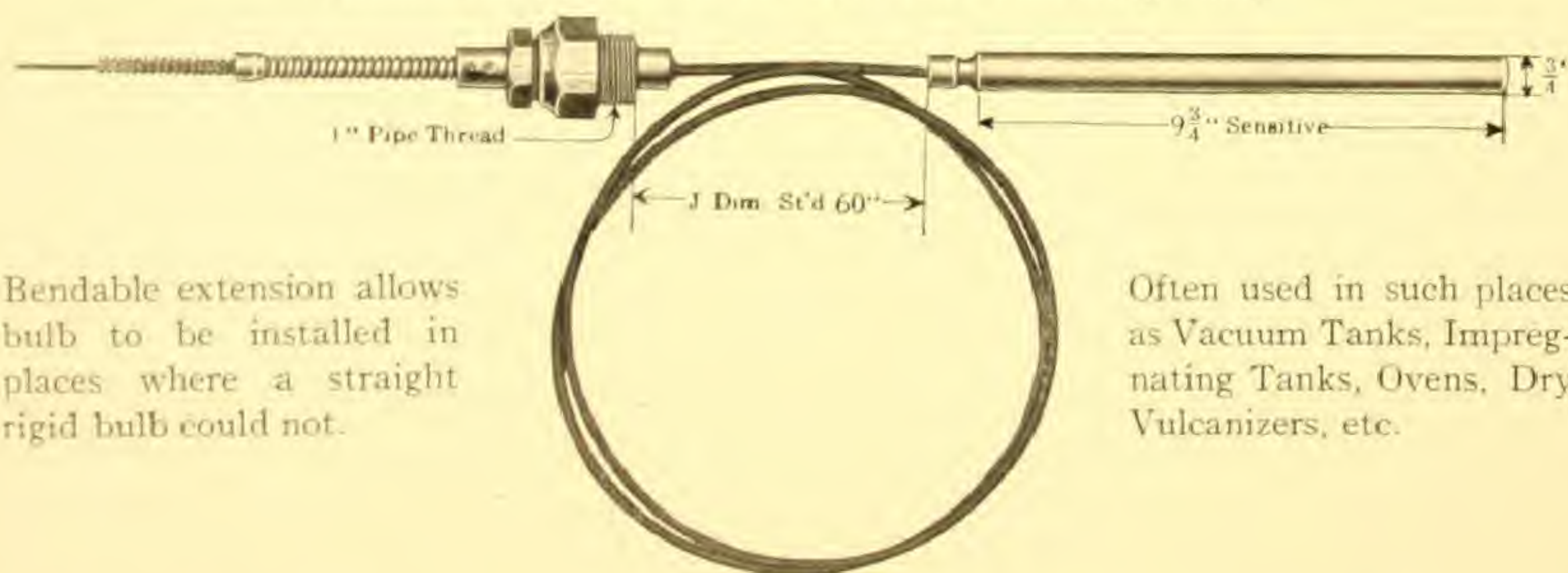
### No. 372—BULB WITH WROUGHT IRON PIPE COVERING (Reinforced Flexible Bronze-Armored Connecting Tube)



The wrought iron pipe gives extra protection and mechanical strength. Although it is an additional covering it is a part of the bulb construction and cannot be removed.

Used wherever a long rugged bulb is required in closed spaces like Powdered Coal Dryers, etc. Not recommended for temperatures below 400°F.

### No. 307—PLAIN COPPER BULB WITH BENDABLE EXTENSION AND THREADED CONNECTION (Reinforced Flexible Bronze-Armored Connecting Tube)



Bendable extension allows bulb to be installed in places where a straight rigid bulb could not.

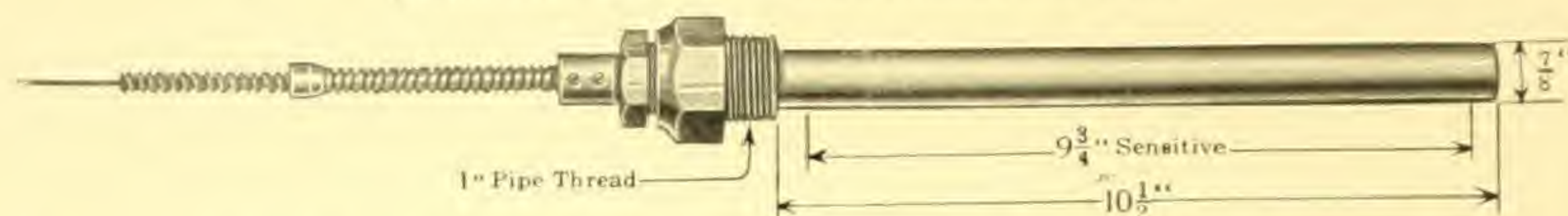
Often used in such places as Vacuum Tanks, Impregnating Tanks, Ovens, Dry Vulcanizers, etc.

The bulb dimensions given on this page are for 25-feet (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.



## Bulbs With Pipe Thread Connection and Separable Socket FOR USE WITH GAS FILLED RECORDING THERMOMETERS

### No. 332—BULB WITH SEPARABLE BRONZE SOCKET (Reinforced Bronze-Armored Connecting Tube)



Same as Bulb No. 322 but with the addition of a Separable Bronze Socket.

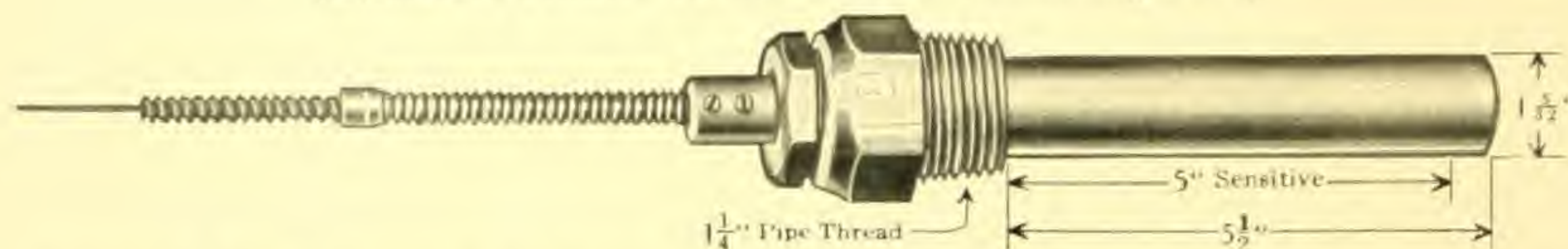
In use this socket is permanently installed. However, the bulb can be inserted or removed at will. Sometimes it is desired to use one thermometer only occasionally at several different locations. For such conditions any

number of sockets can be installed wherever thermometer readings are required.

The applications for this bulb are practically the same as for No. 322.

For use in places where chemicals are present which will attack bronze, separable Sockets can be furnished made of welded steel, or bronze with lead covering.

### No. 337—BULB WITH SEPARABLE BRONZE SOCKET (Reinforced Flexible Bronze-Armored Connecting Tube)

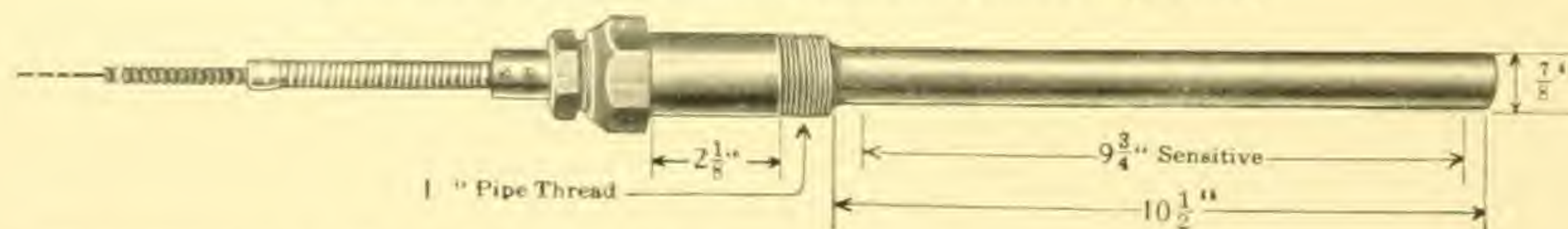


Similar to No. 332, except for dimensions which are shorter in length and greater in diameter. It is for use in places where there is not sufficient room for the longer bulb.

The same general applications apply for this bulb as for No. 332.

Separable Sockets can be furnished made of Welded Steel or Bronze with Lead Covering.

### No. 6392—BULB WITH SEPARABLE BRONZE SOCKET AND EXTENSION FOR LAGGING (Reinforced Flexible Bronze-Armored Connecting Tube)



The extension on the socket of this bulb is provided to allow for the thickness of lagging on tanks, heaters, pipes, etc., where it may be required to install the bulb. The applica-

tions in general are the same as for Bulb No. 332.

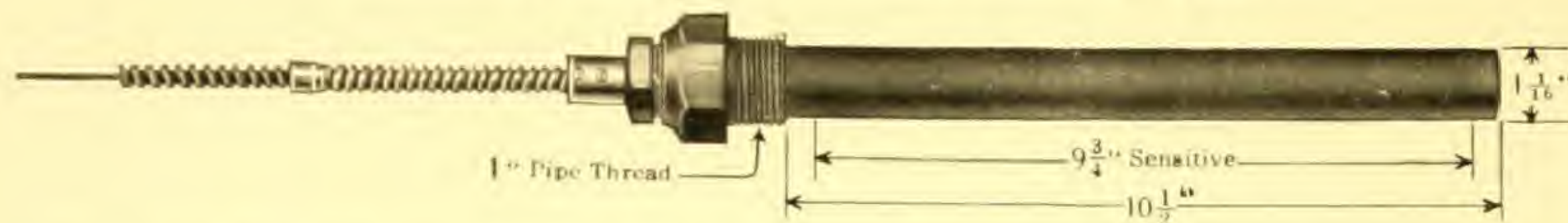
When required the Separable Socket can be furnished made of Welded Steel.

The bulb dimensions given on this page are for 25-feet (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.



## Bulbs With Pipe Thread Connection and Separable Socket FOR USE WITH GAS FILLED RECORDING THERMOMETER

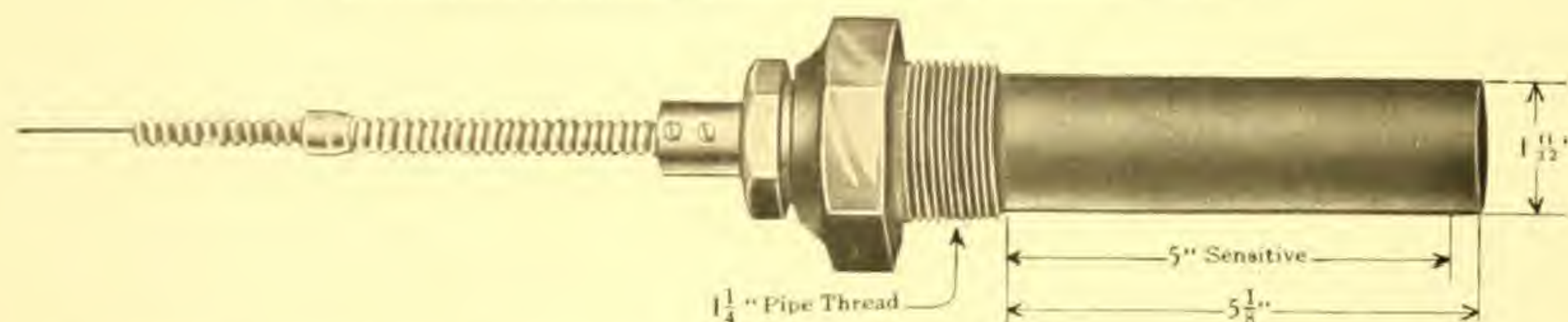
### No. 342—BULB WITH SEPARABLE CAST IRON SOCKET (Reinforced Flexible Bronze-Armored Connecting Tube)



Similar to No. 332 previously described, but has Cast Iron Socket which adapts it for use in connection with pulp dryers, dye vats, etc., where other metals would be attacked by chemicals used in the process.

When to be used in connection with chemicals which attack iron, Separable Sockets can be furnished made of Cast Bronze, Cast Aluminum or Solid Steel or Monel.

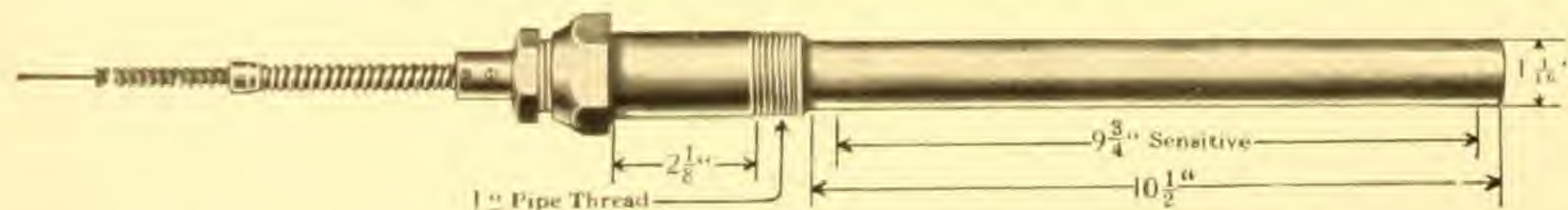
### No. 347—BULB WITH SEPARABLE CAST IRON SOCKET (Reinforced Flexible Bronze-Armored Connecting Tube)



Like No. 342 except for dimensions, which are shorter in length and greater in diameter. The same general applications apply for this

bulb as for No. 342. It is intended for use where space will not permit use of the longer bulb.

### No. 4392—BULB WITH SEPARABLE STEEL SOCKET AND EXTENSION FOR LAGGING (Reinforced Bronze-Armored Connecting Tube)



An extension is provided on this bulb to allow for the thickness of lagging on tanks,

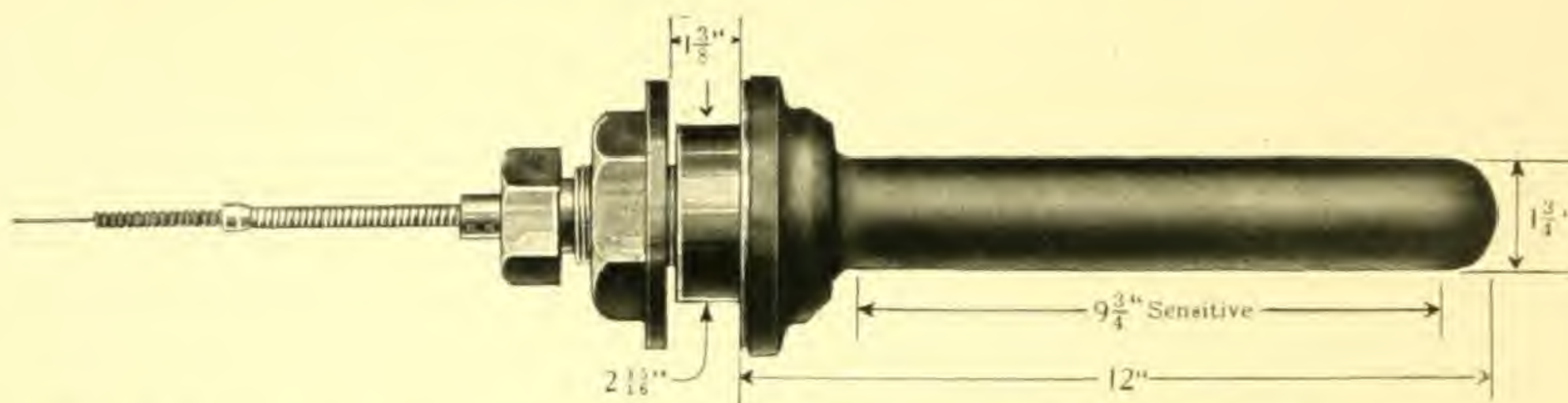
heaters, pipes, etc. The applications in general are the same as for Bulb No. 342.

The bulb dimensions given on this page are for 25-feet (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.



## Bulbs for use with Gas Filled Recording Thermometers

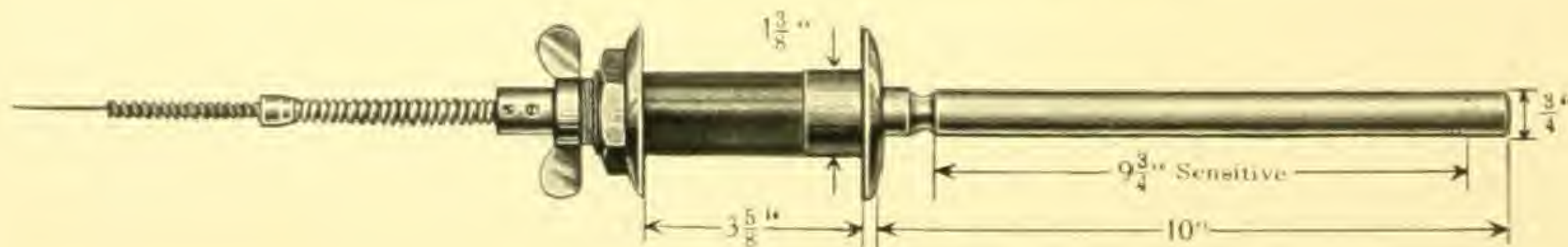
### BULB No. 5342 WITH SEPARABLE EXTRA HEAVY PHOSPHOR BRONZE SOCKET DESIGNED FOR USE ON SULPHITE DIGESTERS (Reinforced Bronze-Armored Connecting Tube)



This bulb is extra strong to give ample mechanical strength, and made of phosphor

bronze which is passive to the acid prevalent in Sulphite Digesters.

### BULB No. 2392 WITH ADJUSTABLE INVERTED LAGGING SLEEVE DESIGNED FOR USE ON TANKS HAVING THICK WALLS (Reinforced Bronze-Armored Connecting Tube)



The adjustable sleeve adapts this bulb for use on metal tanks with double lining, also on wooden tanks having thick walls.

Thumb nut is provided so that the bulb may be easily removed while the lagging sleeve remains in permanent position.

The bulb dimensions given on this page are for 25-feet (standard length) of connecting tube or less. For prices, also variations from the standard, see pages 52 and 53.





*The above shows Bristol's Recording Thermometers and Pressure Gauges used in connection with Sulphite Digesters*

*Recording Core Oven Temperatures*



*In this big Rubber Plant a Bristol's Recording Thermometer is used with every Vulcanizer*



*Recording Engine Tank Temperatures in Ice Plant*



*Moisture Proof Recording Thermometers installed out of doors on Jar Still*



## Charts For Recording Thermometers



### IMPORTANCE OF CHART

The record of temperature on the printed chart is the one big reason why thousands of recording thermometers are now being used. Thus, to serve best, the chart must be suitable to the work in hand. And it is important that care be given to selecting the right chart.

### HOW TO SELECT CHART

In choosing the right chart for your particular requirements consider first—the Total Range. That is, the highest and lowest temperatures which will ever be required to record.

Second—the Average Working Temperatures. Knowing the average working temperatures it is well to select a chart where they will come about two-thirds up on the scale. This is the more open section and it is easier to obtain closer readings. When the working temperatures are low it is desirable to use a chart with reversed scale. In this way placing the record higher up on the chart.

Third—the Clock Speed. By this is meant the time it takes for the chart to make one complete revolution. The clock speeds more often used are 7-day and 24-hour. However,

other faster speeds are sometimes required for test purposes or in connection with special purposes.

### VARIETY OF CHART RANGES

Charts for use with gas filled recording thermometers are listed in the pages following. They offer a big variety of ranges to select from. In case the particular chart needed is not listed and is not already available, it is quite possible one can be developed for you.

### ACCURATE CHARTS NECESSARY

Every recording thermometer is calibrated to be used with the particular chart specified. This makes it necessary that every chart must be identical, without even the slightest variation, in order to insure accuracy. For this reason, every attention is given to the finest details, which make Bristol's charts absolutely accurate and reliable, under all conditions.

### SPECIAL CHART PAPER USED

Even the paper on which Bristol's charts are printed is made specially for the purpose. It has just the right surface coating so that the ink will not blot and yet not too smooth so that the ink will run. Furthermore, the composition of the paper is such that the effect of atmospheric changes is minimized.

### GREAT CARE IN PRINTING

The charts are printed in our own plant from extremely accurate engravings and under uniform humidity conditions. Black ink is the standard color used, and on the white paper stock provides the easiest chart to read.

### GUARANTEE OF ACCURACY

No Bristol's Recording Thermometer can be guaranteed to be accurate unless genuine Bristol's charts are used. In order to identify them, every Bristol's chart is printed on paper having water mark reading "Bristol's." As a further precaution, the name of The Bristol Company is printed in the center of every chart.



## Charts For Recording Thermometers

### CHART REPLACEMENTS

With every new Bristol's Recording Thermometer a supply of one hundred charts is included. Additional replacements can be had at any time.

Bristol's Round Charts are sold by the hundred. When placing orders specify by the hundred or multiple thereof. If otherwise specified, we reserve the right to change the quantity to the nearest multiple of one hundred.



To facilitate delivery Bristol's charts are carried in stock packed in boxes containing one hundred each, as shown in illustration. This box also provides a convenient means of filing the charts and prevents them from becoming soiled by dust or unnecessary handling.

### LIST PRICES

#### BRISTOL'S ROUND CHART:

12-Inch and 10-Inch Diam., per 100	\$1.65
Printed in copying ink, per 100	1.90
7-Day, printed in two colors, per 100	2.20
Onion-skin paper, per 100	2.75

#### BRISTOL'S ROUND CHART:

8-Inch and 6-Inch Diam., per 100	.80
Printed in copying ink, per 100	.95
7-Day, printed in two colors, per 100	1.35
Onion-skin paper, per 100	2.75

### CHART FILES

Usually thermometer chart records are sufficiently valuable to keep on file for future reference. Some concerns use very expensive cabinets for this purpose as shown in the illustration. However, for a convenient and inexpensive method of filing, there are three chart files available as illustrated and listed on this page.



### CHART HOLDER

Wooden chart holder with spindle and metal weight.

For 12-In. or 10-In. Round Chart, \$2.75 List  
For 8-In. or 6-In. Round Chart, 2.20 List

In ordering specify whether for wall or shelf use.



### HORIZONTAL CHART CABINET

Made of oak with polished varnish finish.

For 12-In. or 10-In. Round Chart, \$33.00 List  
For 8-In. or 6-In. Round Chart, 27.50 List



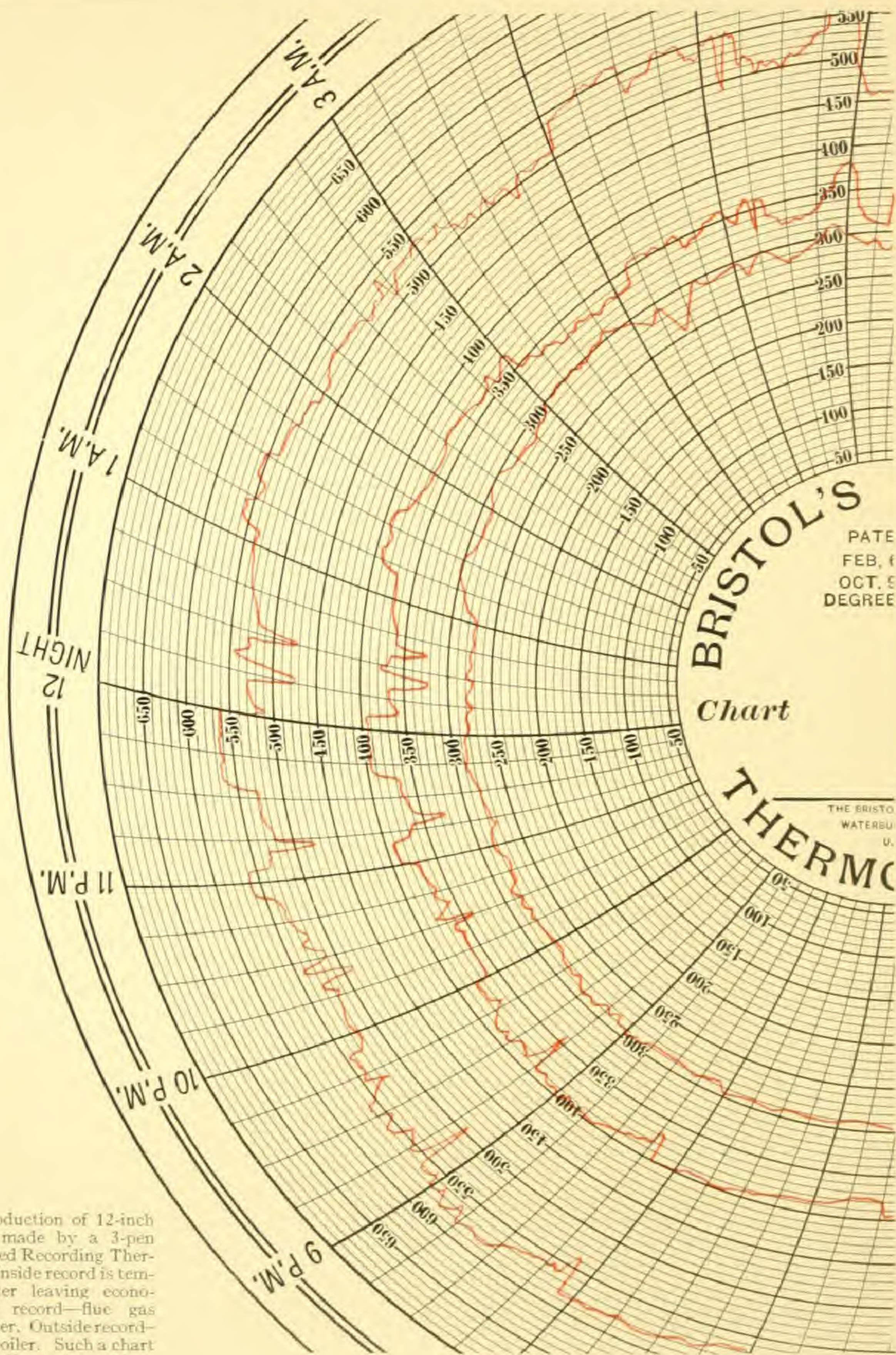
### VERTICAL CHART CABINET

Made of oak with polished varnish finish.

For 12-In. or 10-In. Round Chart, \$33.00 List  
For 8-In. or 6-In. Round Chart, 27.50 List

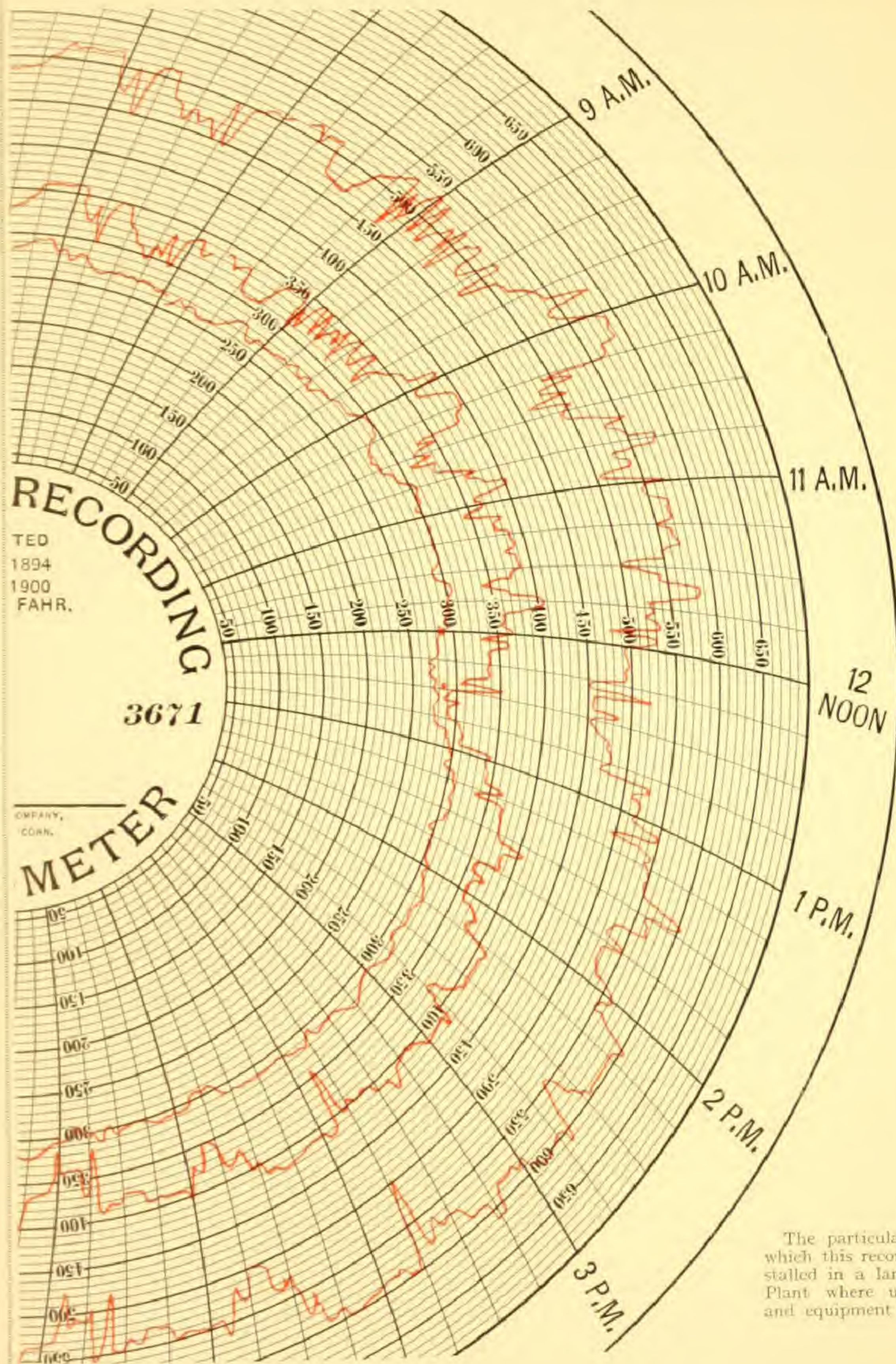






Full size reproduction of 12-inch diameter chart made by a 3-pen Bristol's Gas Filled Recording Thermometer. The inside record is temperature of water leaving economizer. Middle record—flue gas leaving economizer. Outside record—flue gas leaving boiler. Such a chart record gives a direct comparison at three important points.





The particular instrument from which this record was taken is installed in a large Western Power Plant where up-to-date methods and equipment are employed.

ELECTRICITY

MOTION, ETC.



## 12-Inch Charts For Gas Filled Recording Thermometers

### MODELS 311, 312 AND 340

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub.		
732	10-0-90°F	10°	2°	24-hour	Reversed Scale
3699	40-0-100°F	10°	2°	7-day	Reversed Scale
3694	0-100°F	5°	1°	7-day	
734	0-100°F	10°	2°	24-hour	
780	0-100°F	10°	2°	8-hour	
3717	0-100°F	5°	1°	2-hour	
621	20-0-110°F	10°	2°	7-day	Two Colors
645	20-0-110°F	10°	2°	24-hour	
3688	20-0-110°F	10°	2°	12-hour	
3687	20-0-110°F	10°	2°	7-day	Reversed Scale
3666	20-120°F	10°	2°	7-day	Reversed Scale
3617	20-120°F	5°	1°	24-hour	Reversed Scale
3615	60-0-125°F	25°	5°	24-hour	
3606	25-130°F	5°	1°	24-hour	
3660	30-130°F	10°	2°	12-hour	
3677	30-0-150°F	10°	2°	7-day	
793	30-0-150°F	10°	2°	24-hour	
3610	0-150°F	10°	2°	7-day	Two Colors
3616	0-150°F	10°	2°	24-hour	
3661	0-150°F	10°	2°	24-hour	Reversed Scale Vacuum Equivalent
3648	30-150°F	10°	2°	7-day	
3675	30-150°F	10°	2°	24-hour	
758	40-160°F	10°	2°	7-day	Two Colors
3672	40-160°F	10°	2°	24-hour	
3722	20-180°F	10°	2°	7-day	
3670	80-180°F	5°	1°	7-day	
3636	80-180°F	5°	1°	24-hour	
3655	0-200°F	25°	5°	7-day	
3644	80-212°F	5°	1°	7-day	Reversed Scale
3653	80-212°F	5°	1°	24-hour	
3645	30-220°F	25°	5°	24-hour	
794	30-220°F	25°	5°	24-hour	Reversed Scale



## 12-Inch Charts For Gas Filled Recording Thermometers

### MODELS 311, 312 AND 340

Samples of charts will be sent for inspection. When requesting samples, specify the chart number

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub.		
3643	40-220°F	20°	5°	24-hour	Reversed Scale with Mercury Pressure Equivalent
725	40-220°F	20°	5°	24-hour	Reversed Scale
724	40-225°F	25°	5°	7-day	Two Colors
730	40-225°F	25°	5°	24-hour	
3686	40-225°F	25°	5°	12-hour	
3602	40-225°F	25°	5°	2-hour	
3720	30-230°F	5°	1°	24-hour	
3663	40-0-250°F	25°	5°	24-hour	
798	40-250°F	25°	5°	24-hour	
3723	0-300°F	25°	5°	24-hour	
784	40-300°F	25°	5°	7-day	Two Colors
743	140-310°F	10°	2°	24-hour	\$5.00 extra list
3715	0-350°F	25°	5°	24-hour	
3690	100-350°F	25°	5°	7-day	\$5.00 extra list
3710	40-400°F	50°	10°	72-hour	Reversed Scale
736	40-400°F	50°	10°	24-hour	
769	40-400°F	50°	10°	24-hour	
694	40-600°F	100°	20°	7-day	Two Colors
797	40-600°F	50°	10°	24-hour	
3618	200-600°F	25°	5°	24-hour	\$5.00 extra list
3671	40-700°F	50°	10°	24-hour	
788	200-700°F	50°	10°	24-hour	\$5.00 extra list
3613	450-700°F	15°	5°	24-hour	\$10.00 extra list
791	40-800°F	50°	10°	7-day	Two Colors
3716	40-800°F	50°	10°	24-hour	
723	40-800°F	50°	10°	12-hour	
697	40-800°F	100°	20°	1-hour	
3706	200-800°F	50°	10°	24-hour	\$5.00 extra list
3728	400-800°F	25°	5°	24-hour	\$10.00 extra list
3733	0-1000°F	100°	20°	24-hour	With Steel Bulb \$5.00 extra list



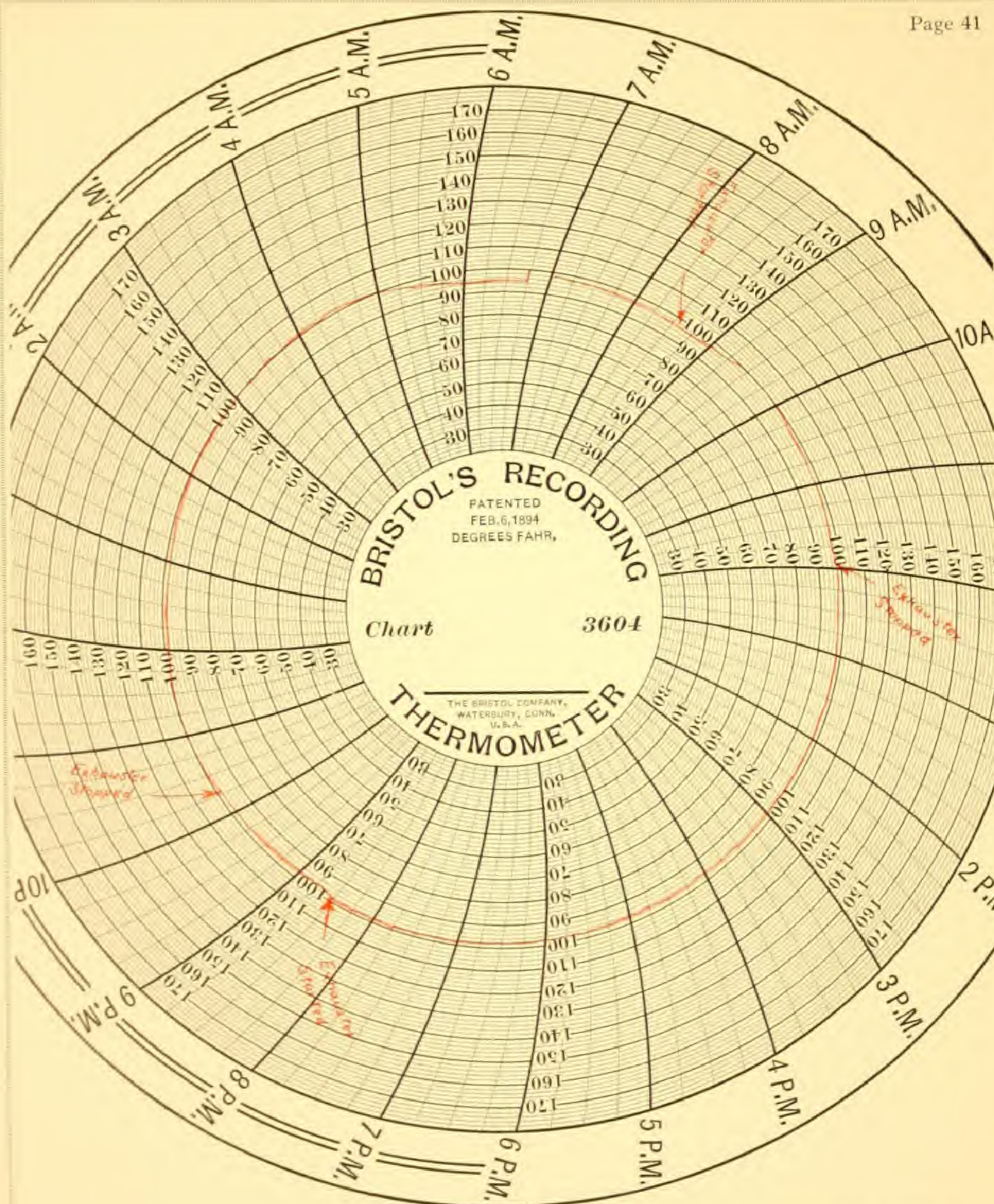
## 12-Inch Charts For Gas Filled Recording Thermometers

MODELS 311, 312 AND 340

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub.		
3731	30-0-40°C	5°	1°	24-hour	Reversed Scale
751	30-0-45°C	5°	1°	7-day	Two Colors
3608	40-0-50°C	5°	1°	7-day	Two Colors
3708	40-0-50°C	10°	2°	24-hour	
3654	0-60°C	5°	1°	24-hour	
3650	5-72°C	5°	1°	24-hour	
727	0-75°C	5°	1°	24-hour	
774	0-100°C	5°	1°	7-day	Two Colors
776	10-100°C	10°	2°	24-hour	
3730	10-100°C	10°	2°	1-hour	
3693	10-0-110°C	10°	2°	24-hour	
750	0-110°C	10°	2°	24-hour	Reversed Scale
3664	65.6-121.1°C	5°	1°	24-hour	
3657	25-130°C	10°	2°	7-day	
748	25-130°C	5°	1°	24-hour	
3659	0-150°C	10°	2°	24-hour	
3633	60-155°C	5°	1°	24-hour	
3639	0-170°C	10°	2°	12-hour	
3635	0-200°C	10°	2°	24-hour	
3629	50-200°C	10°	2°	24-hour	
3691	25-0-220°C	25°	5°	12-hour	
3676	93 1/3-315 5/9°C	25°	5°	24-hour	
673	0-350°C	25°	5°	24-hour	
3695	100-350°C	25°	5°	24-hour	\$5.00 extra list
3729	126-350°C	10°	2°	24-hour	\$5.00 extra list
3642	0-425°C	50°	10°	24-hour	
3632	25-0-25°R	5°	1°	24-hour	
754	5-0-40°R	5°	1°	24-hour	





The above temperature record is on Bristol's Recording Thermometer 8-inch diameter chart, same as used on Models 311, 312 and 340.

It was made at one of the large Southern gas plants and shows temperature of gas passing from meter to storage holder. The bulb is installed at outlet of rotary gas meter.

ELECTRICITY

MOTION, ETC.



## 8-Inch Charts

### For Gas Filled Recording Thermometers

#### MODELS 311, 312 AND 340

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub.		
3600	30-0-70°F	10°	2°	7-day	Two Colors
741	30-0-70°F	10°	2°	24-hour	Reversed Scale
3631	30-0-70°F	10°	2°	24-hour	
3712	10-0-90°F	10°	2°	24-hour	Reversed Scale
3652	40-0-100°F	10°	2°	24-hour	
706	0-100°F	10°	2°	7-day	Two Colors
707	0-100°F	10°	2°	24-hour	
3614	0-100°F	10°	2°	12-hour	
709	20-0-120°F	10°	2°	7-day	Two Colors
3656	20-0-120°F	25°	5°	48-hour	
648	20-0-120°F	10°	2°	24-hour	Reversed Scale
3713	20-0-120°F	10°	2°	24-hour	
752	30-130°F	10°	2°	7-day	Two Colors
787	30-130°F	10°	2°	24-hour	
3623	30-130°F	10°	2°	8-hour	
3637	40-140°F	10°	2°	7-day	
719	40-140°F	10°	2°	24-hour	
722	0-150°F	25°	5°	24-hour	
3646	30-150°F	10°	2°	7-day	
735	50-150°F	10°	2°	24-hour	
3604	20-180°F	10°	2°	24-hour	
783	80-180°F	10°	2°	7-day	Two Colors
3719	80-180°F	10°	2°	24-hour	
3724	30-190°F	10°	2°	24-hour	Reversed Scale
760	40-200°F	25°	5°	7-day	Two Colors
731	40-200°F	25°	5°	24-hour	
757	30-210°F	20°	5°	24-hour	
3640	80-210°F	10°	2°	7-day	
3701	80-210°F	10°	2°	24-hour	
3678	40-220°F	20°	5°	7-day	
3727	40-220°F	20°	5°	24-hour	
3625	30-230°F	25°	5°	7-day	Two Colors



## 8-Inch Charts For Gas Filled Recording Thermometers

### MODELS 311, 312 AND 340

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub.		
3696	40-250°F	25°	5°	7-day	
729	40-250°F	25°	5°	24-hour	
759	40-280°F	25°	5°	24-hour	
720	40-280°F	25°	5°	12-hour	
789	40-300°F	25°	5°	24-hour	
699	40-350°F	50°	10°	7-day	Two Colors
718	40-350°F	50°	10°	24-hour	
785	100-350°F	25°	5°	24-hour	\$5.00 extra list
693	0-430°F	50°	10°	24-hour	
628	40-600°F	100°	20°	7-day	Two Colors
626	40-600°F	100°	20°	24-hour	
680	200-600°F	50°	10°	24-hour	\$5.00 extra list
3612	200-600°F	50°	10°	12-hour	\$5.00 extra list
3673	200-700°F	50°	10°	24-hour	\$5.00 extra list
739	40-800°F	100°	20°	7-day	Two Colors
3707	40-800°F	50°	10°	48-hour	
613	40-800°F	100°	20°	24-hour	
3611	40-800°F	100°	20°	12-hour	
756	300-800°F	50°	10°	24-hour	\$5.00 extra list
3721	200-1000°F	100°	20°	24-hour	With steel bulb. \$5.00 extra list
3685	34-0-21°C	5°	1°	24-hour	
3607	25-0-35°C	5°	1°	24-hour	Reversed Scale
3626	18-0-38°C	5°	1°	24-hour	
3709	18-0-54°C	5°	1°	7-day	
763	18-0-54°C	5°	1°	24 hour	
744	0-56°C	10°	2°	7-day	Two Colors
768	0-56°C	10°	2°	24-hour	
3667	0-60°C	5°	1°	24-hour	
745	0-60°C	5°	1°	24-hour	Reversed Scale
755	0-70°C	10°	2°	24-hour	



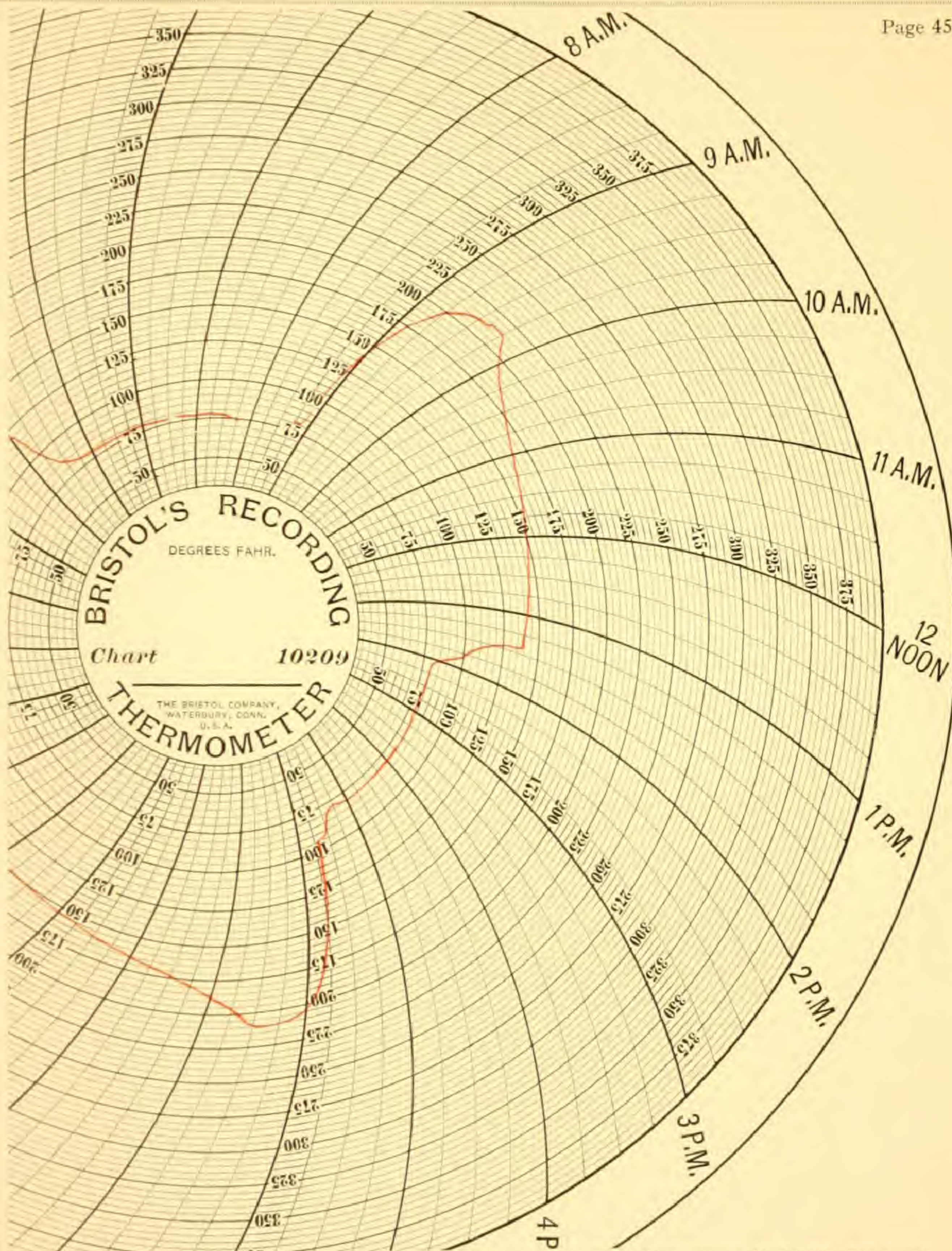
## 8-Inch Charts For Gas Filled Recording Thermometers

MODELS 311, 312 AND 340

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub.		
3689	4.4-93.3°C	10°	2°	24-hour	
3605	20-0-100°C	10°	2°	24-hour	
733	0-100°C	10°	2°	24-hour	
3658	40-100°C	10°	2°	24-hour	
3682	10-0-110°C	10°	2°	24-hour	
3649	0-110°C	10°	2°	24-hour	
786	0-130°C	10°	2°	7-day	Two Colors
3669	0-130°C	10°	2°	24-hour	
3679	0-140°C	10°	2°	24-hour	
3680	40-140°C	10°	2°	24-hour	
782	0-150°C	25°	5°	24-hour	
3665	50-150°C	10°	2°	24-hour	
746	0-200°C	25°	5°	7-day	Two Colors
753	0-200°C	25°	5°	24-hour	
795	40-200°C	25°	5°	24-hour	
3683	40-250°C	25°	5°	7-day	Two Colors
3692	40-250°C	25°	5°	24-hour	
3681	50-250°C	25°	5°	24-hour	
3711	0-300°C	50°	10°	24-hour	
3634	100-300°C	25°	5°	24-hour	\$5.00 extra list
659	0-350°C	50°	10°	7-day	Two Colors
619	0-350°C	50°	10°	24-hour	
3702	148.88-426.66°C	50°	10°	24-hour	\$5.00 extra list
1935	0-430°C	50°	10°	7-day	
3651	0-430°C	50°	10°	7-day	
653	0-430°C	50°	10°	24-hour	
3621	14-0-30°R	5°	1°	7-day	Two Colors
714	14-0-30°R	5°	1°	24-hour	
726	10-80°R	5°	1°	24-hour	





Full size specimen of 10-inch diameter chart as used with Recording Thermometer Model 341. The record shows temperature of steam used for sterilizing bottles at a big dairy plant where they specialize in certified milk. In commenting, the users of this recording thermometer mention the fact that it is valuable to them not only because the chart shows the temperature, but also the length of time the temperature is maintained.

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## 10-Inch Charts

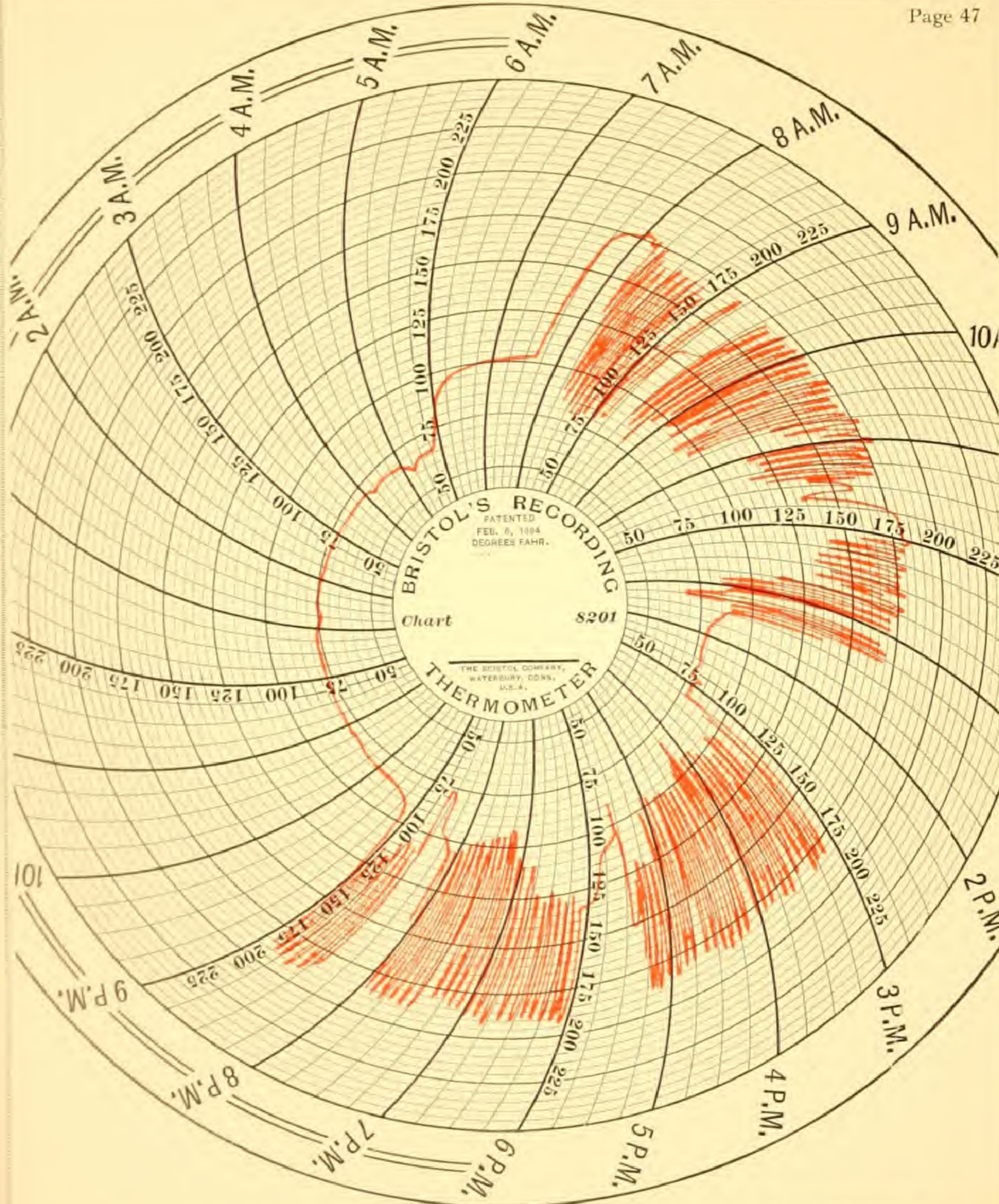
### For Gas Filled Recording Thermometers

#### MODELS 341 AND 343

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub		
10221	{ 0-100°F 0-300°F	10° 25°	2° 5°	24-hour	Double Scale Reversed, Two Pens
10223	0-100°F	10°	2°	24-hour	Reversed Scale
10204	20-0-110°F	10°	2°	24-hour	
10202	0-150°F	10°	2°	7-day	Two Colors
10207	30-150°F	10°	2°	24-hour	
10214	0-200°F	10°	2°	24-hour	
10218	30-220°F	10°	2°	24-hour	Reversed Scale
10208	32-250°F	25°	5°	24-hour	
10221	{ 0-300°F 0-100°F	25° 10°	5° 2°	24-hour	Double Scale Reversed, Two Pens
10209	32-400°F	25°	5°	24-hour	
10200	40-500°F	25°	5°	24-hour	
10215	40-600°F	50°	10°	24-hour	
10219	200-650°F	50°	10°	24-hour	\$5.00 extra list
10217	300-700°F	25°	5°	24-hour	\$5.00 extra list
10222	40-800°F	50°	10°	7-day	
10216	40-800°F	50°	10°	48-hour	
10203	40-800°F	50°	10°	24-hour	
10201	200-800°F	50°	10°	72-hour	\$5.00 extra list
10206	200-800°F	50°	10°	24-hour	\$5.00 extra list
10224	0-60°C	5°	1°	7-day	
10213	0-60°C	5°	1°	24-hour	
10211	0-100°C	10°	2°	24-hour	
10220	0-200°C	5°	1°	7-day	
10212	0-430°C	25°	5°	24-hour	





The above shows an actual 8-inch diameter chart as used with Model 341 Recording Thermometer. The record shows the temperature for hot water heating system used in connection with gas holder at one of the Northwestern cities.

It is noticeable how well the rapid fluctuations are recorded. This is a real test for a recording instrument. It is possible with Bristol's Gas Filled Recording Thermometers because the aging process used in connection with the pressure elements enables them to stand up for many years under just such severe strain.

ELECTRICITY

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MOTION, ETC.



## 8-Inch Charts

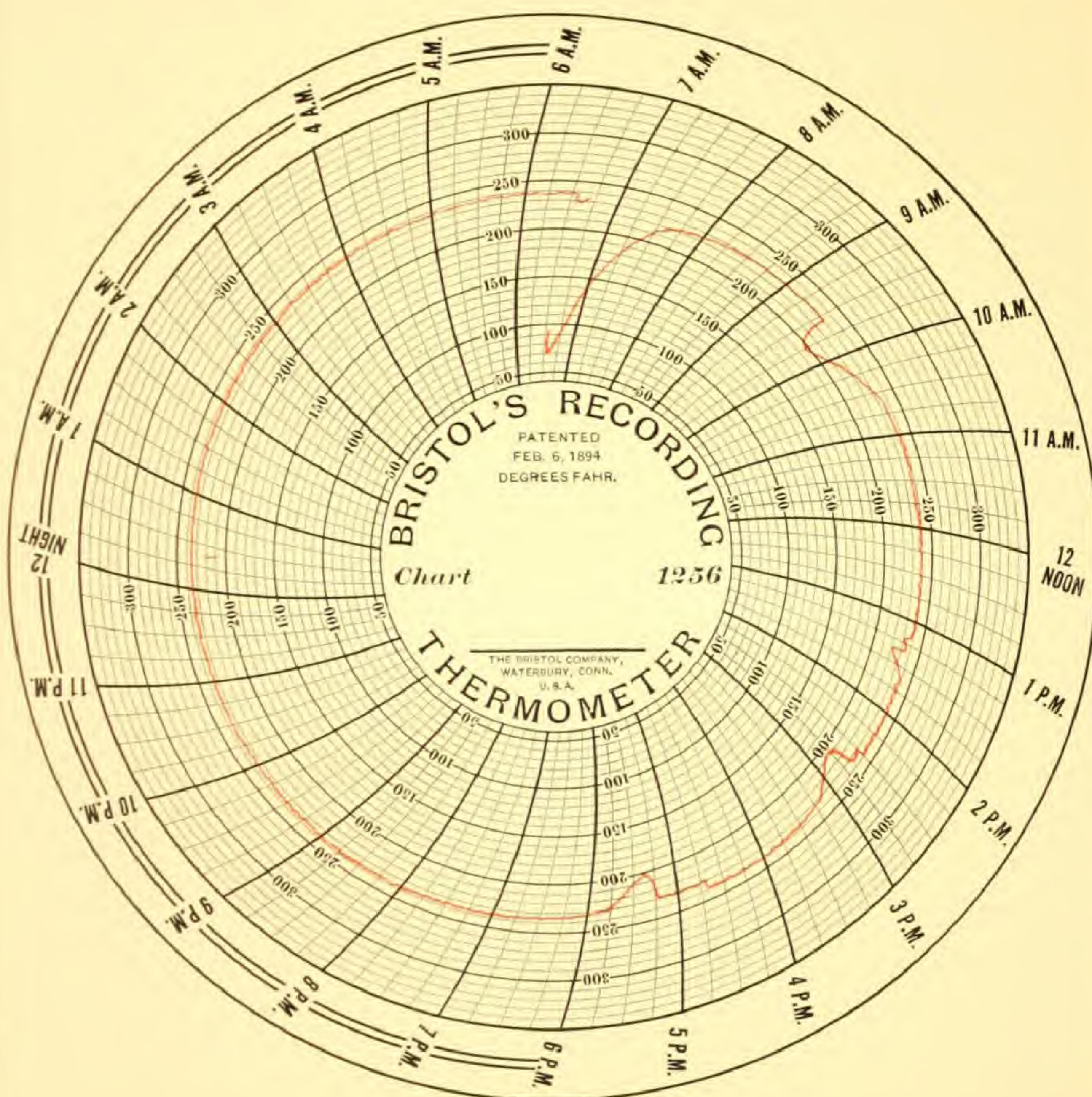
### For Gas Filled Recording Thermometers

#### MODEL 341 AND 343

Samples of charts will be sent for inspection. When requesting samples, specify the chart number

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub		
8211	30-0-70°F	10°	2°	24-hour	
8220	0-100°F	10°	2°	24-hour	
8202	20-0-110°F	10°	2°	24-hour	
8215	30-0-120°F	10°	2°	7-day	
8208	30-0-120°F	10°	2°	24-hour	
8221	30-0-120°F	10°	2°	1-hour	
8210	50-150°F	10°	2°	24-hour	
8217	30-190°F	10°	2°	24-hour	Reversed Scale
8205	30-220°F	25°	5°	24-hour	
8201	40-250°F	25°	5°	24-hour	
8200	40-400°F	50°	10°	24-hour	
8209	40-600°F	50°	10°	24-hour	
8213	40-800°F	50°	10°	7-day	
8207	40-800°F	50°	10°	72-hour	
8204	40-800°F	50°	10°	24-hour	
8216	300-800°F	50°	10°	24-hour	\$10.00 extra list
8219	28.9-0-43.3°C	5°	1°	24-hour	
8218	34.4-0-48.9°C	5°	1°	24-hour	
8214	40-0-60°C	10°	2°	24-hour	
8212	0-100°C	10°	2°	24-hour	
8206	0-300°C	25°	5°	24-hour	





Here is shown a full size 6-inch diameter chart same as used with Model 347 Recording Thermometer.

The record is that of oven temperature for baking insulating varnish on motor windings, and used in one of the large Electric Equipment Manufacturing Plants.

They remark in regard to this particular recording thermometer as follows: "This Instrument with several other Bristol Recording Thermometers are in constant use in our plant, and we are glad to say they require very little attention."

ELECTRICITY

MOTION, ETC.



## 6-Inch Charts

### For Gas Filled Recording Thermometers

#### MODEL 347

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

Chart No.	Range	Scale Divisions		One Rev. of Chart	Remarks
		Main	Sub		
1262	30-0-70°F	10°	2°	7-day	Two Colors. Reversed Scale
1279	30-0-70°F	10°	2°	24-hour	
1258	10-0-90°F	10°	2°	24-hour	Reversed Scale
1270	0-100°F	10°	2°	7-day	Two Colors
1250	0-100°F	10°	2°	24-hour	
1272	20-0-110°F	10°	2°	7-day	Two Colors
1290	20-0-110°F	10°	2°	24-hour	
1261	0-130°F	10°	2°	34-hour	
1252	40-140°F	10°	2°	24-hour	
1273	0-150°F	25°	5°	24-hour	
1265	10-150°F	10°	2°	7-day	Two Colors
1277	50-150°F	10°	2°	72-hour	
1283	80-180°F	10°	2°	7-day	
1280	80-180°F	10°	2°	24-hour	
1291	80-180°F	10°	2°	7-day	Reversed Scale
1276	40-200°F	25°	5°	7-day	Two Colors
1266	40-200°F	25°	5°	24-hour	
1281	80-210°F	25°	5°	7-day	Reversed Scale
1285	80-210°F	25°	5°	7-day	
1257	40-225°F	25°	5°	24-hour	
1268	40-0-250°F	25°	5°	24-hour	
1282	40-280°F	25°	5°	7-day	
1256	40-350°F	50°	10°	24-hour	
1263	40-400°F	50°	10°	24-hour	
1275	40-500°F	50°	10°	24-hour	
1274	100-600°F	50°	10°	24-hour	
1251	250-650°F	50°	10°	24-hour	\$5.00 extra list
1260	250-750°F	50°	10°	24-hour	\$5.00 extra list
1255	40-800°F	100°	20°	24-hour	
1284	350-800°F	50°	10°	7-day	\$5.00 extra list
1269	350-800°F	50°	10°	24-hour	\$5.00 extra list
1295	0-1000°F	100°	20°	24-hour	\$5.00 extra list. Steel Bulb
1288	0-100°C	10°	2°	24-hour	



## 6-Inch Charts For Gas Filled Recording Thermometers

### MODEL 347

Samples of charts will be sent for inspection. When requesting samples, specify the chart number

Chart No.	Range	Scale Division		One Rev. of Chart	Remarks
		Main	Sub		
1293	0-120°C	10°	2°	7-day	
1259	0-120°C	10°	2°	24-hour	
1264	40-200°C	25°	5°	24-hour	
1278	0-350°C	50°	10°	24-hour	
1292	0-430°C	50°	10°	24-hour	



*Bristol's Recording Thermometers used to record core oven temperature, an important factor in the foundry*



ELECTRICITY

MOTION, ETC.



## List Prices

Prices given below are for Standard Finish Case and 25-foot Standard Armored Capillary Connecting Tube. With each instrument is included 100 Charts, Bottle of Bristol's Special Recording Instrument Ink, Padlock and Key.

BULB		INSTRUMENT		CHART			
No.	Shown on Page	Model No.	Shown on Page	12-Inch	10-Inch	8-Inch	6-Inch
302	24	311	7	\$83.00		\$72.00	
		340	8	88.00		77.00	
		312	5	88.00		77.00	
		341	9		\$66.00	61.00	
		343	16		81.00	76.00	
		347	10				\$55.00

With the above prices for Bulb No. 302 as a base, use schedule on opposite page to determine List Prices on Thermometers equipped with other Bulbs; also variations in length of Connecting Tube.

**OTHER THAN STANDARD ARMOR.** When required Steel-Armor, Bendable-Copper or Bendable-Steel can be furnished at the same price as the Standard Armor. For Double-Armor of bronze or steel, add 22 cents List per foot. Prices on other forms of protection quoted on request.

**CONNECTING TUBE AND BULB DIMENSIONS.** When Connecting Tube is required for shorter lengths than 25-feet, specify lengths having the multiple of five and in pricing deduct \$2.20 List for every 5-feet. When Thermometer equipment is required having Connecting Tube longer than 25-feet, if the total chart range is less than 400°F., it is necessary to increase the volume of gas in the working system; this is taken care of by increasing the bulb length. Thus, for  $\frac{3}{4}$ -inch diameter bulbs, such as Nos. 302, 312, etc., for every additional 5-feet of Connecting Tube or fraction, the bulb length is increased by 2-inches. For 1-inch diameter bulbs, like Nos. 304, 327, etc., the length is increased 1-inch. See prices on opposite page.

**BULB FINISHES.** Copper Bulbs listed in this catalog when required will be tinned or nickel-plated at no extra charge. For silver-plating or gold-plating on copper bulbs, a charge of \$5.00 extra list is made.

**ARRANGEMENT OF CONNECTIONS.** "Front Connected" or "Back Connected." (Front Connected Instruments are standard and will be furnished unless otherwise specified.) For "Back Connected" add \$5.00 extra list per bulb except for Model 343.

**FLANGES ADJUSTABLE.** For use in connection with Plain Bulbs like 302, Adjustable Flanges can be supplied. Prices as follows: Split Brass Flange, List \$2.50 each; Iron Flange with Set Screw, List \$0.85 each.

ALL PRICES ON THIS PAGE ARE F. O. B. WATERBURY, CONN.



## List Prices

Use the Schedule below in connection with List Prices for  
Bulb No. 302, on opposite page.

Bulb No.		Shown on Page	Thermometers with 25-feet of Connecting Tube — to List Prices given for Bulb No. 302 on opposite page ADD—	Thermometers with Connecting Tube longer than 25-feet and to be used with Instrument having total chart range of—	
				Less than 400°F. For every 5-ft. or fraction ADD—	400°F. or over. For every 5-ft. or fraction ADD—
302	(On opposite page)	24	\$0.00	\$2.75	\$2.20
302	(Of Steel)		5.00	3.30	2.20
2302		24	1.00	2.75	2.20
2302	(Of Steel)		6.00	3.30	2.20
304		26	2.00	3.30	2.20
0304		26	3.00	3.30	2.20
307		29	9.00	2.75	2.20
312		24	2.00	3.30	2.20
3312		25	6.00	3.30	2.20
3312	(Of Steel)		11.00	3.30	2.20
315	(With Weatherhouse)	15	20.00	Quoted	2.20
322		27	6.00	2.75	2.20
327		27	7.00	2.75	2.20
332		30	11.00	3.30	2.20
332	(With Welded Steel Socket)		11.00	3.30	2.20
332	(With Lead Covered Socket)		14.00	3.85	2.20
337		30	12.00	3.30	2.20
337	(With Welded Steel Socket)		12.00	3.30	2.20
337	(With Lead Covered Socket)		15.00	3.85	2.20
342		31	16.00	3.30	2.20
342	(With Cast Bronze Socket)		17.00	3.30	2.20
342	(With Solid Steel Socket)		17.00	3.30	2.20
342	(With Cast Aluminum Socket)		17.00	3.30	2.20
342	(With Solid Monel Socket)		22.00	Quoted	2.20
5342		32	50.00	Quoted	2.20
347		41	17.00	3.30	2.20
347	(With Solid Steel Socket)		18.00	3.30	2.20
352		28	9.00	3.30	2.20
352	(With Steel Union)		9.00	3.30	2.20
353		28	9.00	3.30	2.20
353	(With Steel Union)		9.00	3.30	2.20
357		29	10.00	3.30	2.20
357	(With Steel Union)		10.00	3.30	2.20
362		25	0.00	2.75	2.20
372		29	2.00	2.75	2.20
1392		27	10.00	2.75	2.20
2392		32	11.00	2.75	2.20
4392		31	18.00	3.30	2.20
6392		30	14.00	3.30	2.20

ALL PRICES ON THIS PAGE ARE F. O. B. WATERBURY, CONN.

ELECTRICITY

MOTION, ETC.



## Directions For Ordering

In ordering Bristol's Gas Filled Recording Thermometers specify the following:

1. MODEL NUMBER of Recording Instrument.
2. FINISH of Recording Instrument.  
(Black Enamel is the standard finish on all models except 312, which is wood, and will be furnished unless otherwise specified.)
3. ARRANGEMENT OF CONNECTIONS of Recording Instrument, i. e., "front connected" or "back connected."  
(Front connected instruments are standard and will be furnished unless otherwise specified.)
4. MAXIMUM TEMPERATURE to which sensitive bulb will ever be exposed.
5. AVERAGE WORKING TEMPERATURES to be recorded.
6. MINIMUM TEMPERATURE of which it is important to have a clear record.
7. SIZE OF CHART or dial, i. e., 12-inch, 10-inch, 8-inch or 6-inch.
8. REVOLUTION OF CHART, i. e., 7-day, 24-hour, 12-hour or 1-hour, etc.
9. CHART NUMBER.
10. KIND OF FLEXIBLE CONNECTING TUBE, i. e., bronze-armored, steel-armored or lead-armored.
11. LENGTH OF FLEXIBLE CONNECTING TUBE needed between recording instrument and sensitive bulb.  
(Standard length, 25-feet, and will be furnished unless otherwise specified.)
12. BULB NUMBER. In selecting bulb it should be remembered that the entire sensitive portion should be immersed or exposed to the medium or temperature of which a record is desired.
13. APPLICATION for which recording instrument is to be used.  
(In ordering these thermometers it is often desirable that the customer submit a sketch outlining method of applying sensitive bulb.)

### TELEGRAPHIC ORDERS

In ordering regularly listed Bristol's Gas Filled Recording Thermometers furnished with standard finishes and complete with standard length of connecting tube and standard bulbs, as listed on pages 52 and 53, the orders for these may be specified more briefly as follows:

(1) MODEL NUMBER (2) CHART NUMBER (3) BULB NUMBER

### DRILLING DIMENSIONS

The variety of instruments makes it impractical to include drilling dimensions in this catalog. When this information is required in advance of receiving instrument, blue prints for this purpose will be mailed on request.





### INK FOR RECORDING THERMOMETER

In addition to the charts, Ink is the only other supply required. With each recording thermometer a one-ounce bottle of ink is included. This is packed in a carton complete with glass dropper, as illustrated.

The ink is specially prepared to use with Bristol's Recording Instruments. Ordinary commercial writing ink containing a high percentage of acid is not suitable, because it is quick-drying and has a tendency to corrode metals. This special Bristol's Recording Instrument Ink is slow-drying, and one filling of the pen insures a perfect record for 24-hours.

The Special Dropper holds just enough ink for one filling of the pen. This avoids the use of too much ink, which would overflow and cause smudgy records. It is particularly important when used by careless workmen, or those unaccustomed to handling the finer grade of tools.

### COLORS OF INK

Red is the standard color of Bristol's Special Recording Instrument Ink and is always furnished unless otherwise specified. However, when required for more than one record on the same chart or for other reasons, the following colors, blue, black, green, brown, yellow, orange and violet can be furnished at the same price as quoted below. When other than red ink is desired, be sure to specify color.

### LIST PRICES

Bristol's Special Recording Instrument Ink:

One-ounce Bottle	\$0.30
Two-ounce Bottle	.45
Four-ounce Bottle	.65
Half-pint Bottle	1.10
Pint Bottle	1.90
Quart Bottle	3.30
Combination Rubber Stopper and Glass Filler	.11

### RADII-AVERAGING INSTRUMENT



The Radii-Averaging Instrument like that shown above is used to determine the mean or average temperature as recorded on round charts having uniform scale records, and thus, is applicable to any round chart used with Bristol's Gas Filled Recording Thermometers listed in this catalog. The information thus secured, in connection with records of temperature is often very valuable.

This instrument is well adapted for the work required. It is complete in every detail, including mahogany finish case having compartments. The cover of the case, when open, is detachable and is used to hold the chart for averaging record, and is equipped with socket for mounting instrument.

A plotted curve is furnished with each chart so that the readings obtained by the Averaging Instrument may be readily interpreted.

Bristol's Radii-Averaging Instrument complete with special case and one diagram, \$22.00 List Price, Extra diagrams each, \$1.00 List Price.



TRADE MARK  
**BRISTOL'S**  
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**The Most Extensive Line of Recording Instruments  
 In The World**

PRESSURE AND VACUUM  
 Bristol's Recording Pressure and Vacuum Gauges

LIQUID LEVEL  
 Bristol's Recording Water Level Gauges

TEMPERATURE  
 Bristol's Class I Recording Thermometers      Bristol's Class II Recording Thermometers  
                                          Bristol's Class III Recording Thermometers  
 Bristol's Indicating and Recording Electric Pyrometers      Bristol's Temperature Controllers

HUMIDITY  
 Recording Wet and Dry Bulb Thermometers

ELECTRICITY  
 Bristol's Recording Voltmeters      Bristol's Recording Ammeters      Bristol's Recording Wattmeters  
                                          Wm. H. Bristol Recording Milli Voltmeters      Wm. H. Bristol Recording Shunt Ammeters  
                                          Bristol's Recording Frequency Meters

TIME  
 Bristol's Electric Time Recorders

MOTION  
 Bristol's Mechanical Time Recorders

SPEED  
 Bristol's Recording Tachometers

MISCELLANEOUS  
 Supplies for Bristol Recording Instruments      Bristol-Durand Radii Averaging Instruments  
                                          Gaugeboard Clocks      Bristol Engine Counters      Bristol Revolution Counters

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 Rialto Bldg.



# BRISTOL'S TEMPERATURE CONTROLLER

## MODEL 177

*For Ranges -30 to +150°F*



Fig. 2263

DISTANCE TYPE  
MODEL 177 CONTROLLER



Fig. 2282

SELF-CONTAINED TYPE  
MODEL 177 CONTROLLER  
FOR ROOM TEMPERATURES

The Bristol's Temperature Controller described in this bulletin is a Thermostat Type of Thermometer, built for industrial use. The result of development extending over many

years, insuring accuracy in design and construction, thus making it dependable under all reasonable conditions.

### TEMPERATURE RANGE

The instrument is an Indicating Thermometer of the Liquid Filled Type (not mercury).

It is suitable for installations within temperature ranges between -30 and +150° Fahrenheit.

### ADAPTABILITY

Two Types make this Thermostat adaptable for practically every kind of installation ever required of it. Self-contained for mounting directly at the location where the temper-

ature control is required; and the Distance Type with flexible connecting tube between the sensitive bulb and the instrument, which permits the bulb to be installed several feet away.

### OPERATION

When in use, the sensitive bulb is exposed to the temperature to be controlled. This bulb contains a liquid which expands as the temperature rises. The bulb is in turn connected to an elongated Bourdon Tube Spring wound in the form of a helix, thus as the liquid ex-

pands it generates a pressure which causes the spring to unwind. Attached to the spring is a shaft and Pointer which indicates the temperature on the thermometer scale. The result is a thermometer having a positively actuated pointer.

### ADJUSTABLE CONTACTS

On either side of the pointer are Adjustable Contacts which can be set at any temperature within the range of the scale. The pointer cannot pass either Contact without completing a circuit. If, for any reason, the temperature

goes beyond the bounds of the desired control, it makes no difference how high or low on the scale the indicating arm moves, the circuit through contacts continue, until the pointer passes in the opposite direction and releases it.



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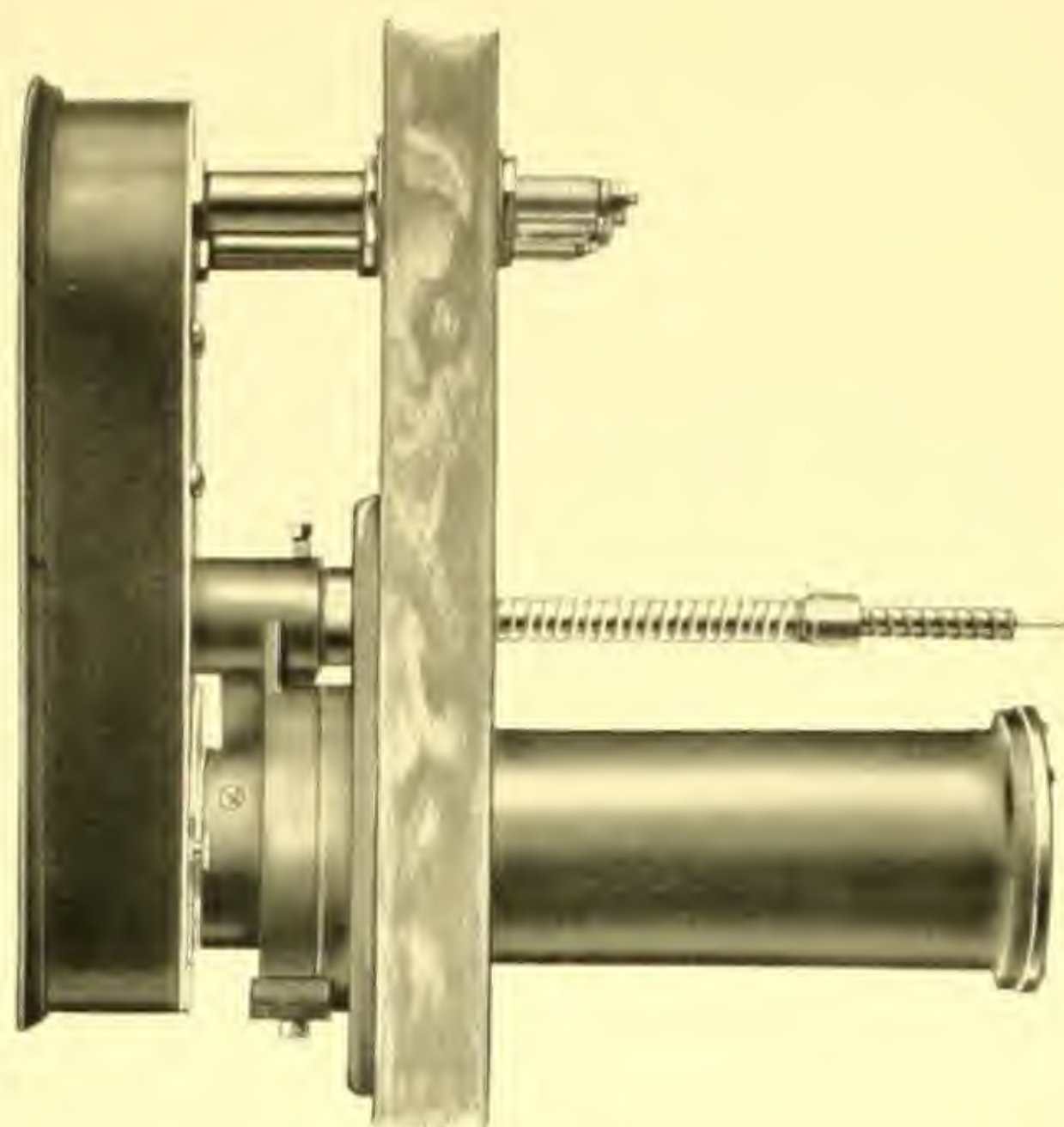


Fig. 2265

## FLUSH TYPE CONTROLLER

MODEL 177

This shows a sectional view of the Controller applied to a panel or switchboard where it is preferred not to have the instrument extend out beyond the switches, etc., mounted near it. The flexible connecting tube passes through the board and all electrical connections are made in the rear of the panel.

## ELECTRICAL CAPACITY OF CONTACT

The Contacts are made of the very best material for the purpose, which was determined upon after exhaustive experiments were conducted. Not less than 100,000 "makes" and "breaks" at the maximum load for which they are designed, may be expected before atten-

tion is necessary. To obtain the longest life possible of the contact, no one of the following maximum conditions should ever be exceeded:

- Maximum Power—50 Watts
- Maximum Current— $\frac{1}{2}$  Ampere
- Maximum Voltage—220 Volts

## ZERO ADJUSTER

A Zero Adjuster operated from the outside of case, is provided to reset the reading of the thermostat, when it is desired to make it agree

with other thermometers measuring the same temperature.

## FLEXIBLE CONNECTION

The standard length of connecting tube furnished to use with this Model 177 Controller is three feet. However, when required it can be supplied up to five feet long. Where longer

lengths than five feet are necessary, it is sometimes possible to furnish it, providing the exact temperature conditions along the connecting tube are known when calibrating the instrument.

## ELECTRICAL INSULATION

All electrical connections and leads are amply insulated. In fact, each instrument is tested at 1200 volts, which is far in excess of the maxi-

mum voltage for which it may ever be expected to carry. The equipment is also inspected and accepted by the Underwriters.

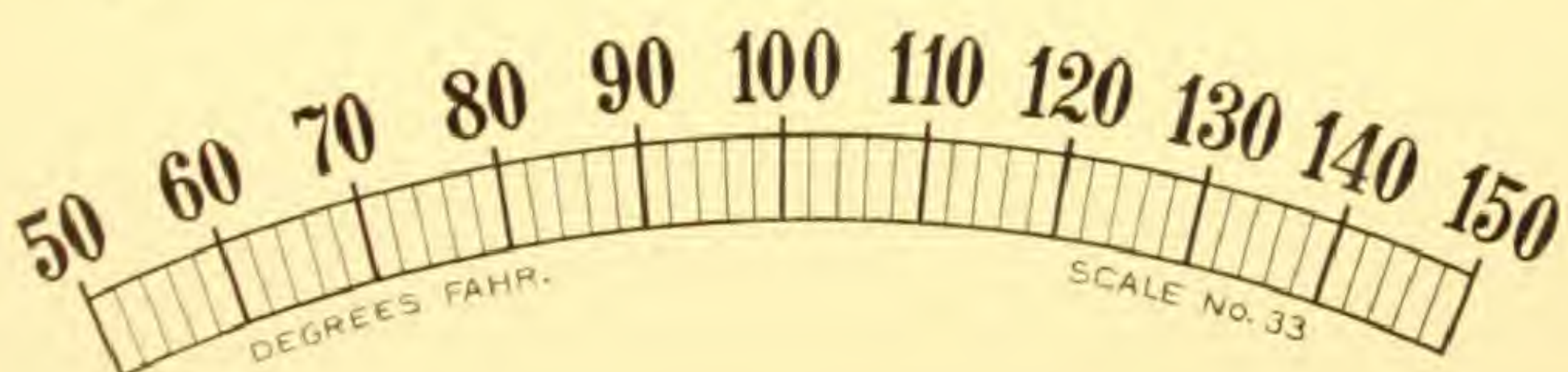
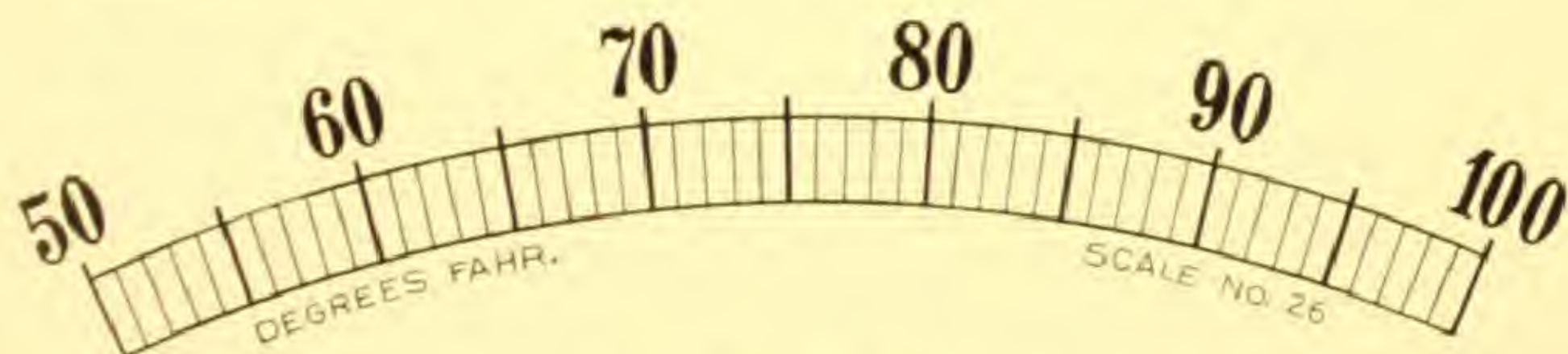
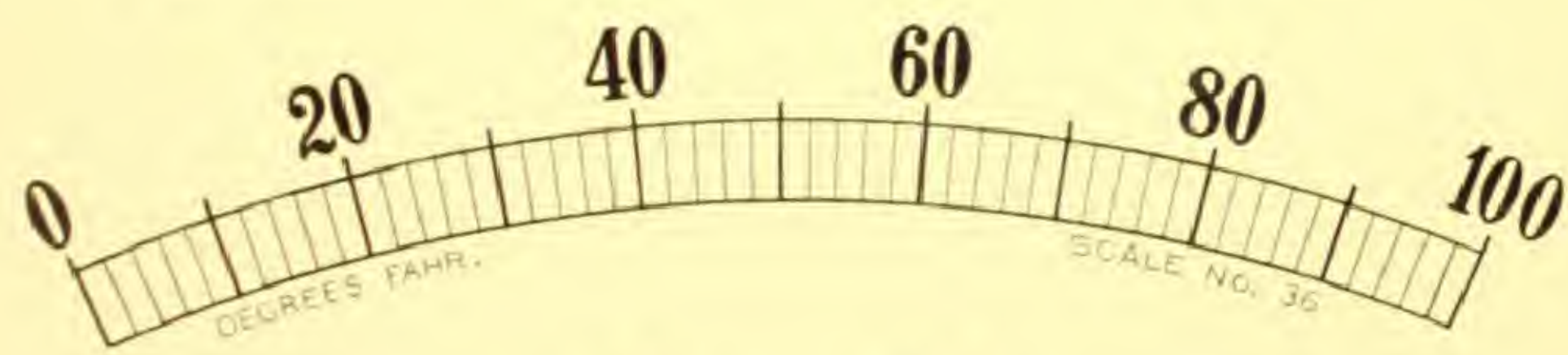
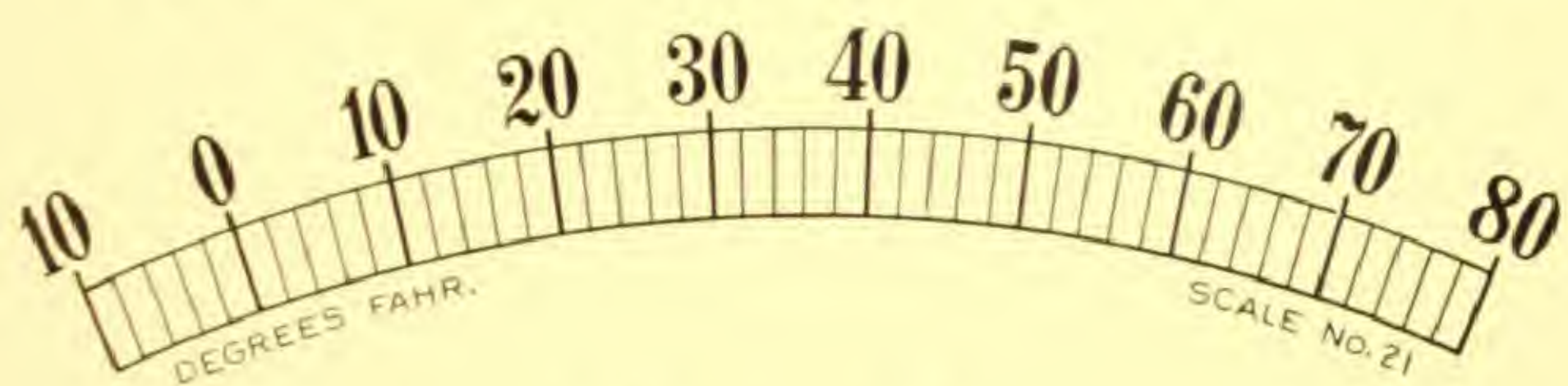
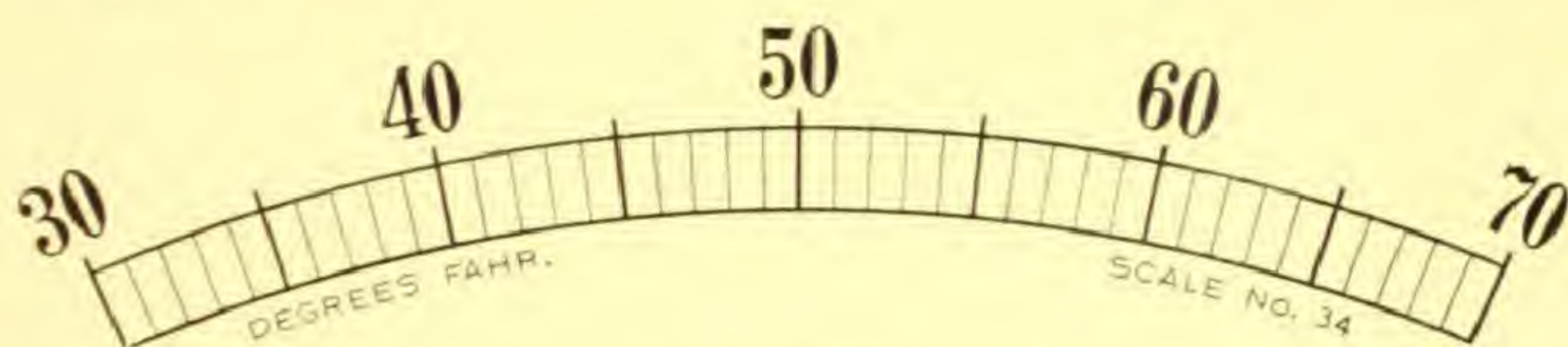
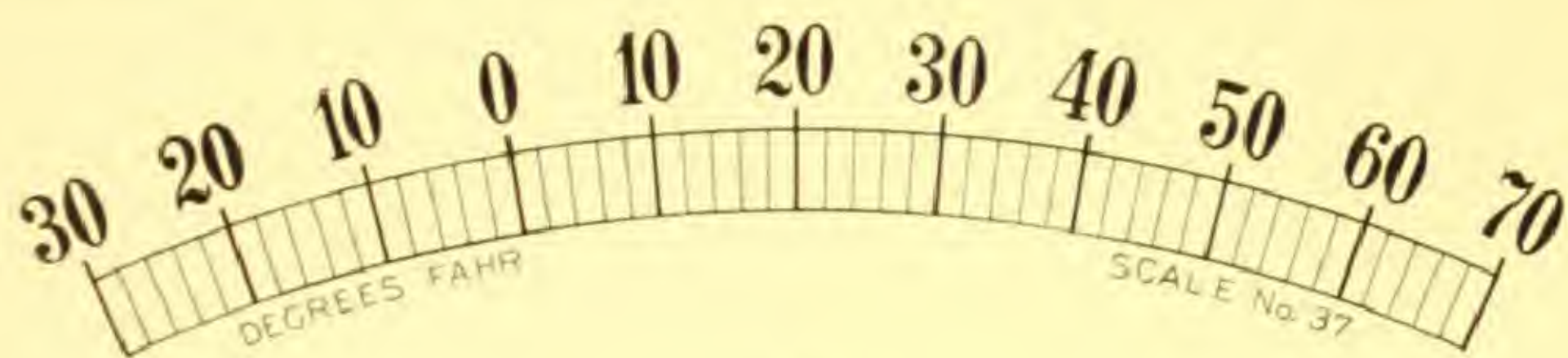


## TEMPERATURE CONTROLLER MODEL 177

### SCALES

Temperature Scales with white background and black lines and figures, are provided with all Model 177 Controllers. The scale is furnished principally to permit an accurate setting of the adjustable contacts to the control

point. It, however, also serves to show the cycle of temperature, and is very valuable for this purpose when a recording instrument is not also used. Several specimen scales (in actual size) are shown below.



TEMPERATURE

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
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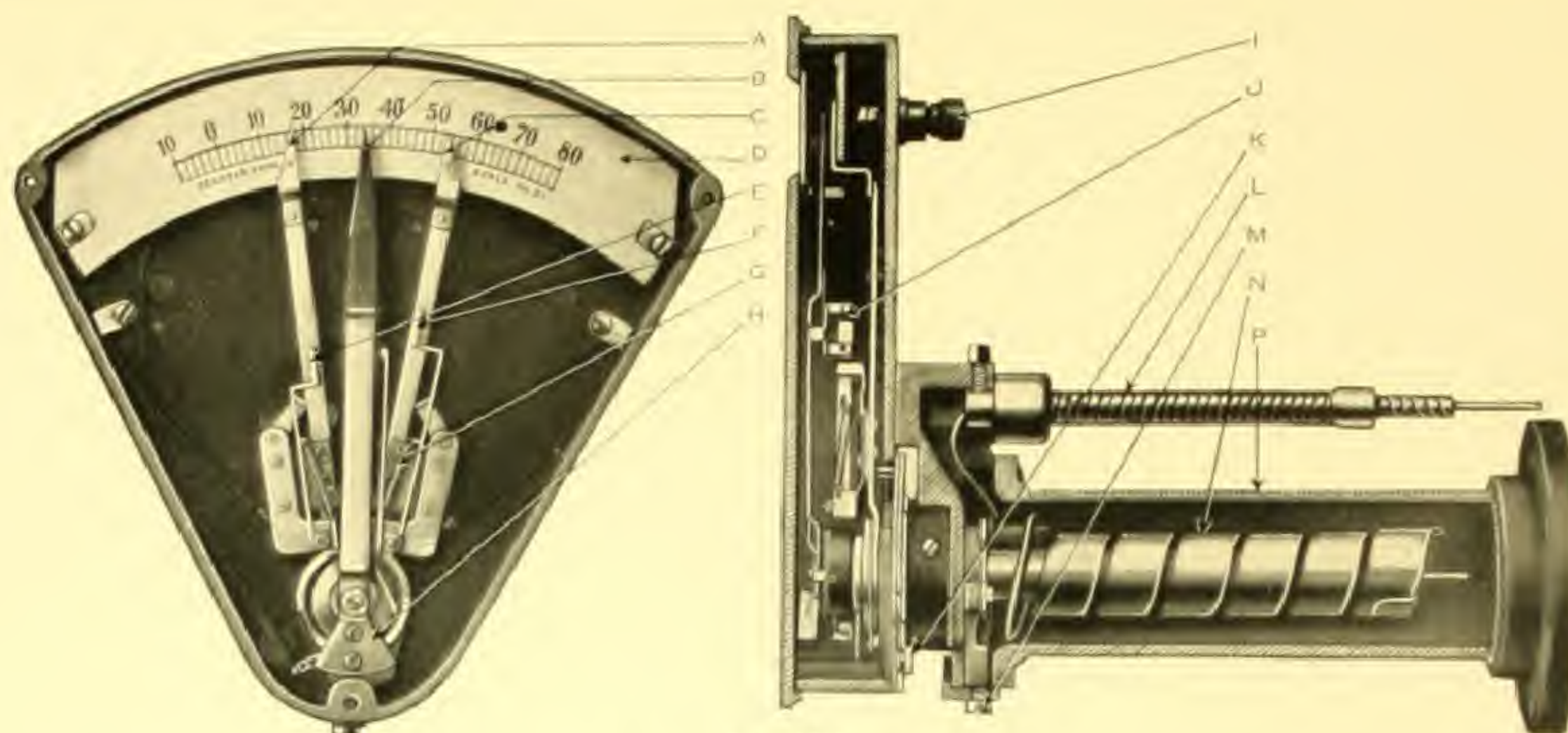


Fig. 2268

### DETAILS OF CONSTRUCTION OF THERMOSTAT MODEL 177

A—LOW ADJUSTABLE CONTACT ARM.  
B—INDICATING POINTER.  
C—HIGH ADJUSTABLE CONTACT ARM.  
D—SCALE PLATE.  
E—LOW ADJUSTABLE CONTACT.  
F—HIGH ADJUSTABLE CONTACT.  
G—CONTACT SPRING.  
H—POINTER COUNTERWEIGHT.  
I—BINDING POSTS.

J—INDICATING POINTER CONTACT.  
K—BUTTON FOR ADJUSTING CONTACT ARMS FROM OUTSIDE OF CASE.  
L—ARMORED CAPILLARY TUBING EXTENDING TO BULB.  
M—ZERO ADJUSTOR.  
N—SENSITIVE PRESSURE SPRING.  
P—PRESSURE SPRING HOUSING, ALSO FORMING BRACKET TO FASTEN INSTRUMENT TO WALL.

In Figure 2268 the adjustable contact arms are shown several degrees apart. Each of these arms can be set independently to any point on the scale, and when set close together the indicating pointer moves about  $\frac{1}{32}$  of an inch to

leave one contact and touch the other. The indicating pointer and each of the adjustable contact arms are electrically connected to binding post on the rear of the case.

### SENSITIVE BULB

To accommodate the Controller for various kinds of applications several styles of Sensitive Bulbs are available. Any Bulb shown in

The Bristol Company Catalog No. 1103 can be furnished with Controller Model 177.

### SOME PRACTICAL USES OF CONTROLLER

Some of the uses for which the Controller is adapted are: Ringing Alarm Bells—Lighting Lamp Banks for Signal Lights—Lighting Three Light Control Signal Systems—Operating Relay for Magnet Switch—Operating Controller Valves for Heating Systems, including Bristol-Fuller Controller Valves and

Bristol Solenoid Valves—Operating Bristol's Electric Time or Operation Recorders—Starting and Stopping Motors for Ventilating Fans, Refrigeration Systems, Exhausters, Temperatures in Fire Protection Tanks, Temperatures in Rooms, etc.

## THE BRISTOL COMPANY

WATERBURY, CONN.

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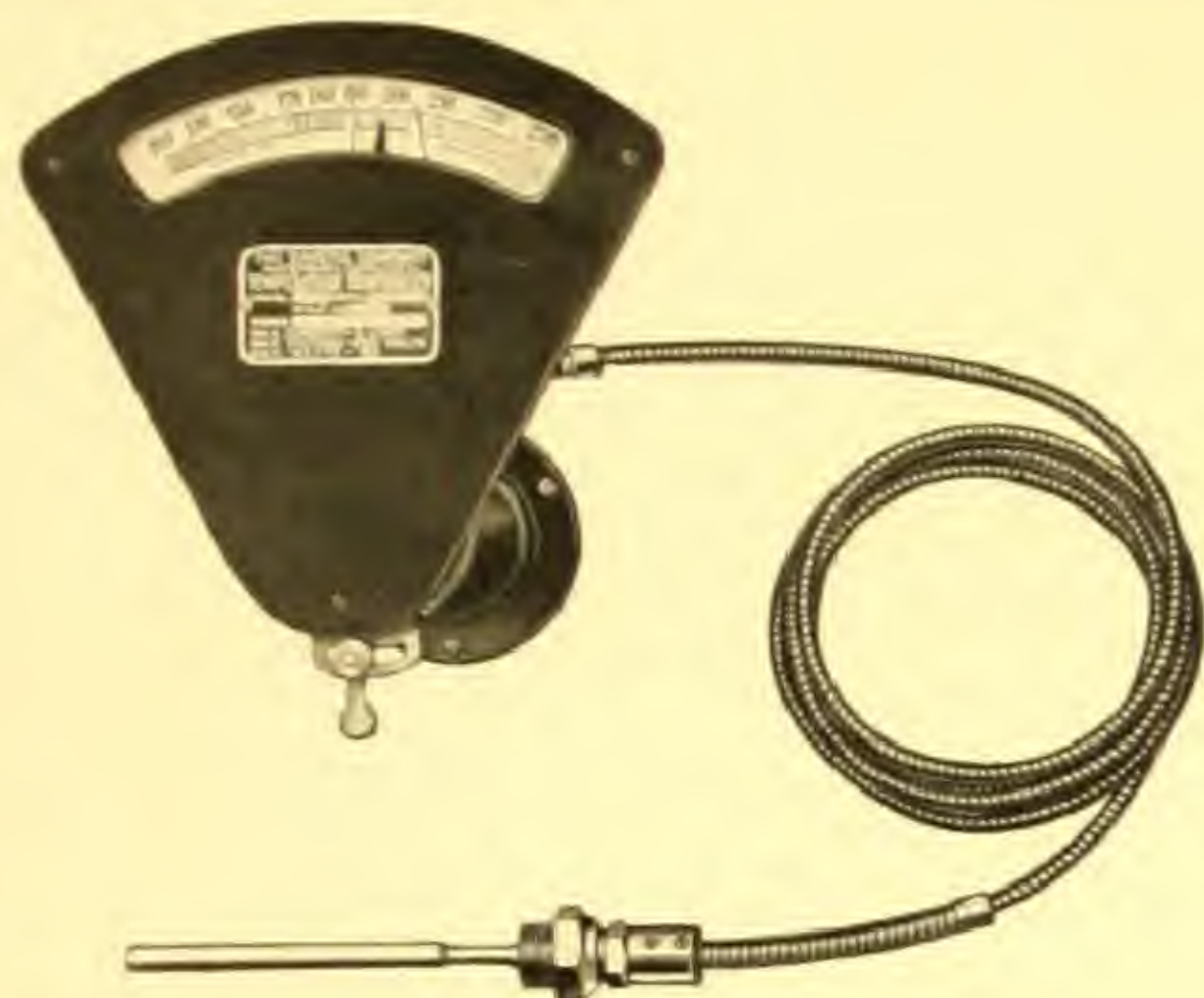
Price furnished on request



# BRISTOL'S TEMPERATURE CONTROLLER

## MODEL 277

*For Ranges 30 to 500° F*



Model 277 Controller is shown here complete with 25-feet (standard length) of flexible connecting tube and Sensitive Bulb No. 222. Other bulbs suitable for practically every requirement can also be furnished, see Catalog 1203 for illustrations and descriptions.

The Bristol's Temperature Controller described in this bulletin is a Thermostat Type of Thermometer, built for industrial use. The result of development extending

over many years, insuring accuracy in design and construction, thus making it dependable under all reasonable conditions.

### TEMPERATURE RANGE

The instrument is an Indicating Thermometer of the "Vapor Tension" type. It is

suitable for installations within temperature ranges between 30 and 500° Fahrenheit.

### ADAPTABILITY

This controller is adaptable for practically every kind of installation ever required of it. The Distance Type with flexible connecting tube between the sensitive bulb and the instrument, permits the bulb to be

installed several feet away, through partitions, inside ovens, in pipe lines, etc., which would otherwise be inaccessible. A wide choice of bulbs makes the range of applications even more flexible.

### OPERATION

The sensitive bulb is exposed to the temperature to be controlled. This bulb contains a liquid which vaporizes at low temperatures, and the pressure of the vapor varies in proportion to the temperature changes. The bulb is in turn connected by a capillary tubing to an elongated Bourdon

Tube Spring wound in the form of a helix. Thus, as the vapor expands it generates a pressure which causes the spring to unwind. Attached to the spring is a shaft and pointer which indicates the temperature on the thermometer scale. The result is a thermometer having a positively actuating pointer.

### ADJUSTABLE CONTACTS

On either side of the pointer are Adjustable Contacts which can be set at any temperature within the range of the scale. The pointer cannot pass either Contact without completing a circuit. If, for any reason, the temperature goes beyond the bounds of the

desired control, it makes no difference how high or low on the scale the indicating arm moves, the circuit through contacts continues, until the pointer passes in the opposite direction and releases it.

TEMPERATURE

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

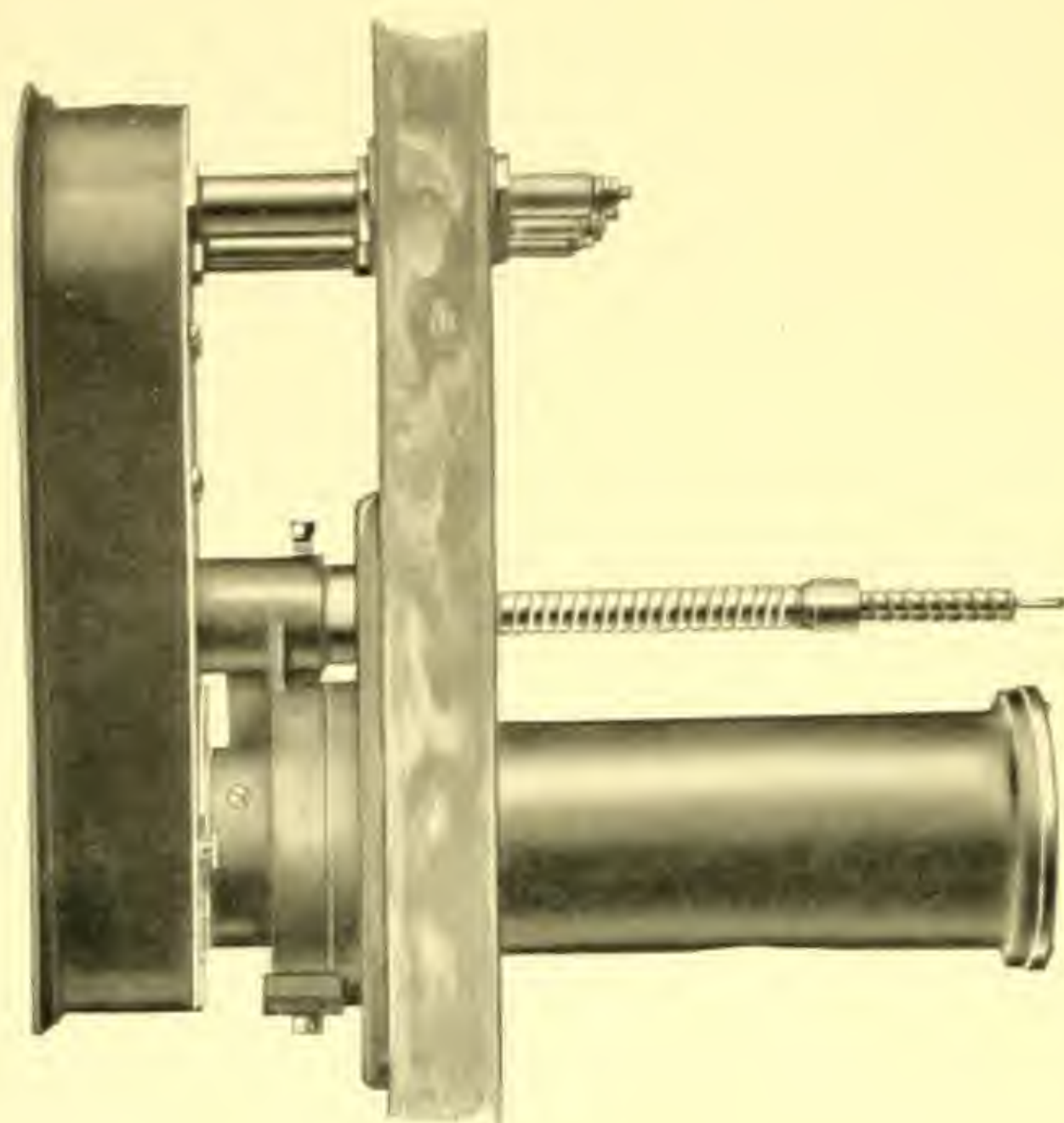


Fig. 2265

## FLUSH TYPE CONTROLLER

MODEL 280

This shows a sectional view of the Controller applied to a panel of switchboard where it is preferred not to have the instrument extend out beyond the switches, etc., mounted near it. The flexible connecting tube passes through the board and all electrical connections are made in the rear of the panel.

## ELECTRICAL CAPACITY OF CONTACT

The Contacts are made of the very best material for the purpose, and was determined upon after exhaustive experiments were conducted. Not less than 100,000 "makes" and "breaks" at the maximum load for which they are designed, may be expected before attention is necessary. To obtain the longest

life possible of the contact, no one of the following maximum conditions should ever be exceeded.

Maximum Power — 50 Watts  
Maximum Current —  $\frac{1}{2}$  Ampere  
Maximum Voltage — 220 Volts

## ZERO ADJUSTER

A Zero Adjuster operated from the outside of case, is provided to reset the reading of the thermostat, when it is desired to make

it agree with other thermometers measuring the same temperature.

## FLEXIBLE CONNECTION

The standard length of connecting tube furnished to use with Controllers Models 277 and 280 is twenty-five feet. However, when required it can be supplied up to one

hundred feet long. Where longer lengths than twenty-five feet are desired, information should be given in regard to the temperature changes which may occur along the connecting tube.

## ELECTRICAL INSULATION

All electrical connections and leads are amply insulated. In fact, each instrument is tested at 1200 volts, which is far in excess of

the maximum voltage for which it may ever be expected to carry. The equipment is also inspected and accepted by the Underwriters.

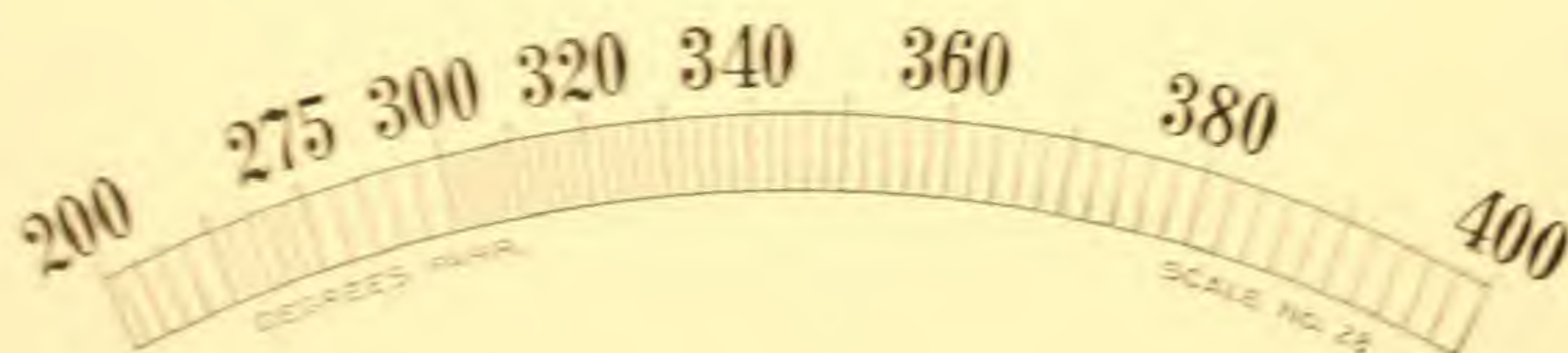
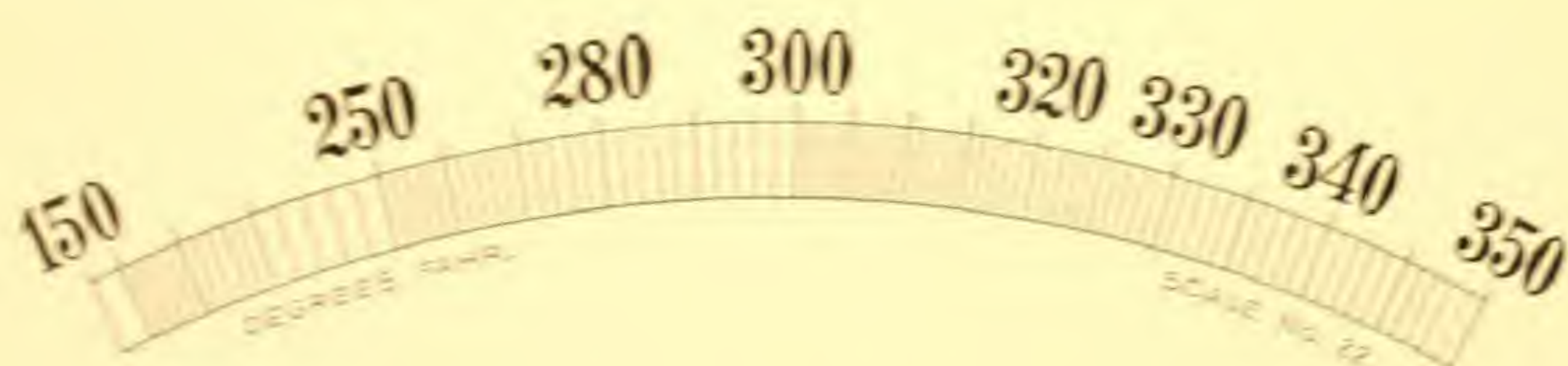
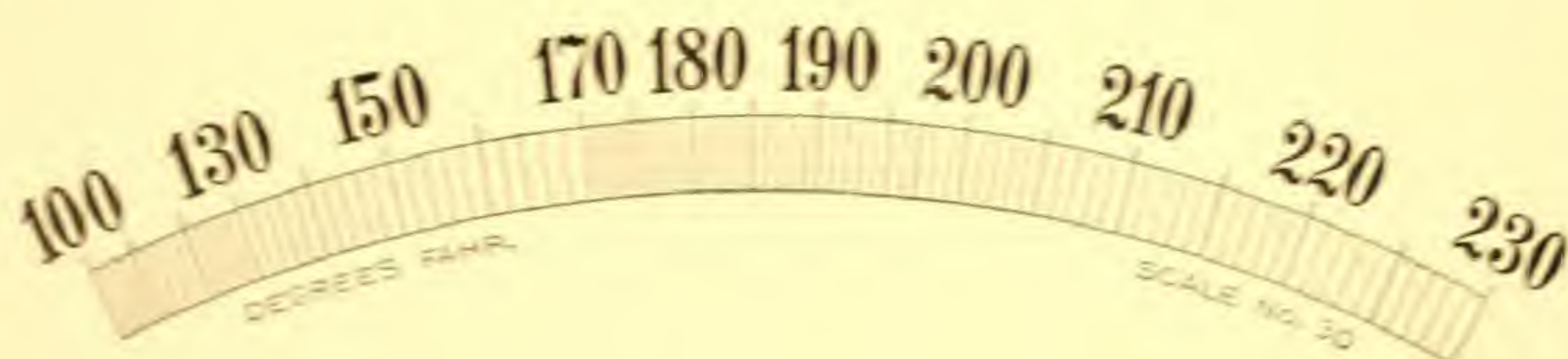
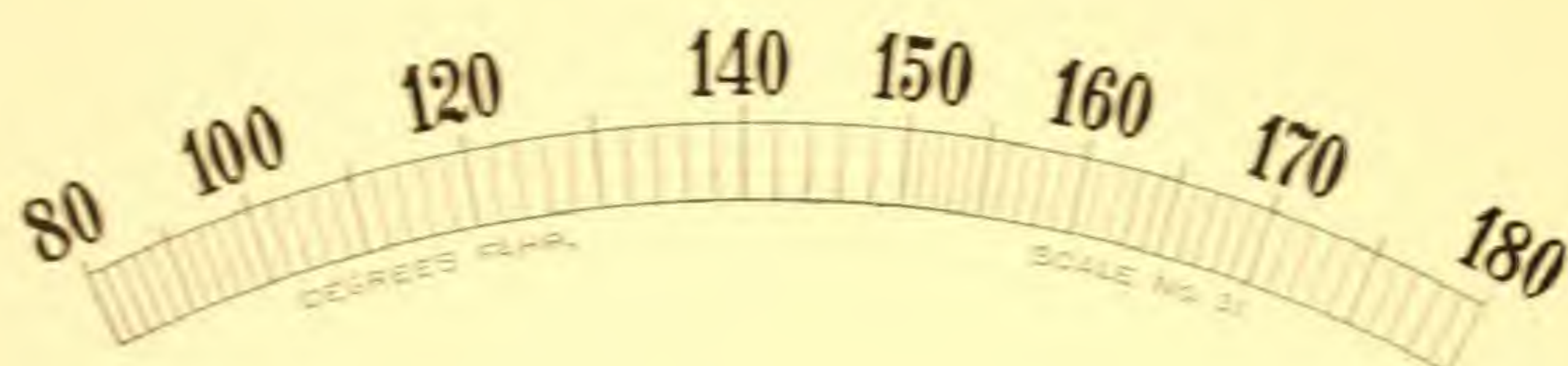


## TEMPERATURE CONTROLLER MODEL 277

### SCALES

Temperature Scales with white background and black lines and figures, are provided with all Controllers Models 277 and 280. The scale is furnished principally to permit an accurate setting of the adjustable contacts to

the control point. It, however, also serves to show the cycle of temperature, and is very valuable for this purpose when a recording instrument is not also used. Several specimen scales (in actual size) are shown below.



NOTE: Scales reading in Degrees Centigrade can also be furnished when desired.

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

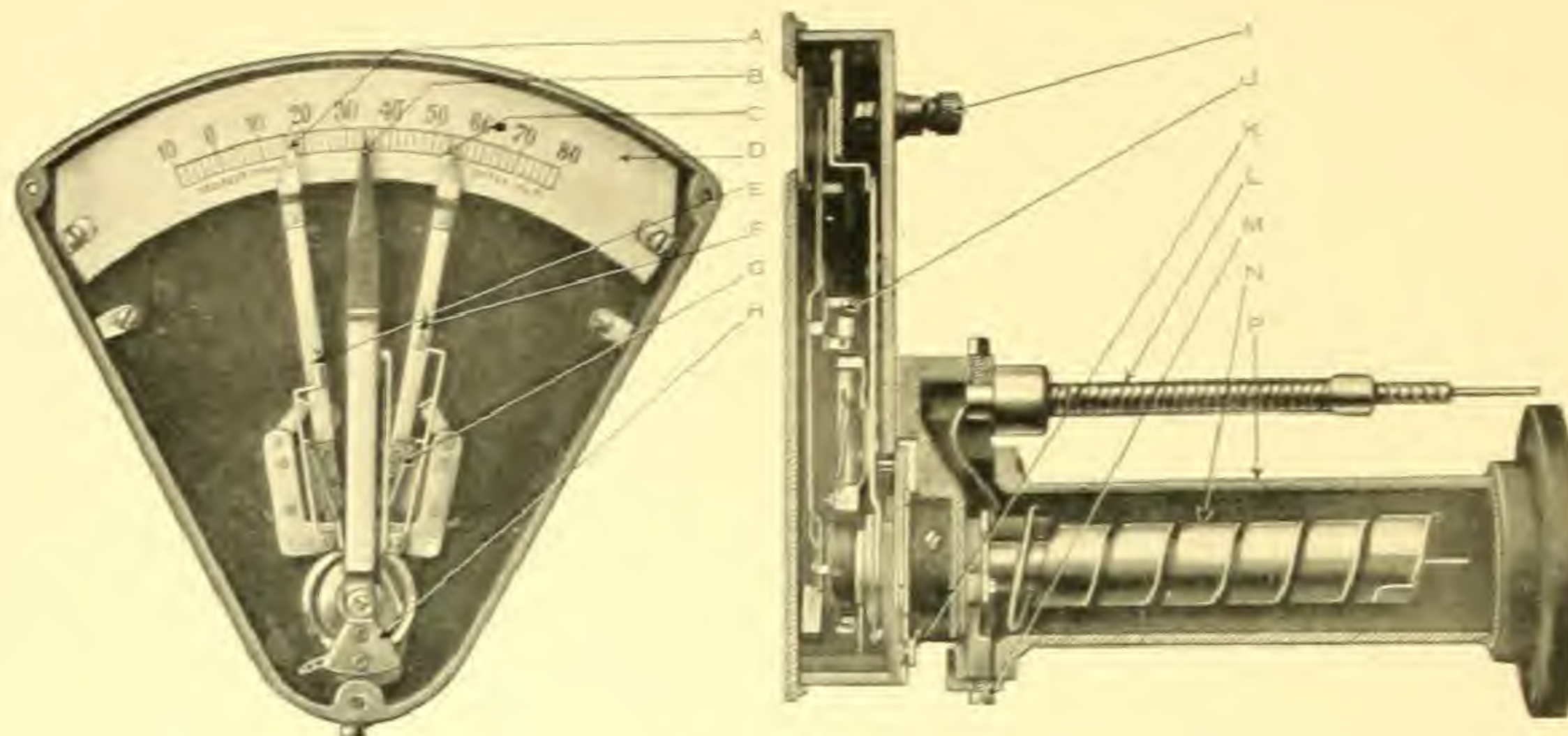


Fig. 2268

## DETAILS OF CONSTRUCTION OF CONTROLLER MODEL 277

A—LOW ADJUSTABLE CONTACT ARM  
B—INDICATING POINTER.  
C—HIGH ADJUSTABLE CONTACT ARM.  
D—SCALE PLATE.  
E—LOW ADJUSTABLE CONTACT.  
F—HIGH ADJUSTABLE CONTACT.  
G—CONTACT SPRING.  
H—POINTER COUNTERWEIGHT.  
I—BINDING POSTS.

J—INDICATING POINTER CONTACT.  
K—BUTTON FOR ADJUSTING CONTACT ARMS FROM OUTSIDE OF CASE.  
L—ARMORED CAPILLARY TUBING EXTENDING TO BULB.  
M—ZERO ADJUSTOR.  
N—SENSITIVE PRESSURE SPRING.  
P—PRESSURE SPRING HOUSING, ALSO FORMING BRACKET TO FASTEN INSTRUMENT TO WALL.

In Figure 2268 the adjustable contact arms are shown several degrees apart. Each of these arms can be set independently to any point on the scale, and when set close together the indicating pointer moves about

1/32 of an inch to leave one contact and touch the other. The indicating pointer and each of the adjustable contact arms are electrically connected to binding post on the rear of the case.

## SENSITIVE BULB

To accommodate the Controller for various kinds of applications several styles of Sensitive Bulbs are available. Any Bulb shown

in The Bristol Company Catalog No. 1203 can be furnished with Controller Model 277.

## SOME PRACTICAL USES OF CONTROLLER

Some of the uses for which the controller is adapted are:

Ring Alarm Bells—Lighting Lamp Banks for Signal Lights—Lighting Three Light Control Signal System—Operating

Relays for Magnet Switch—Operating Controller Valves for Heating Systems, including Bristol-Fuller Controller Valves and Bristol Solenoid Valves—Operating Bristol's Electric Time or Operation Recorders.

## THE BRISTOL COMPANY WATERBURY, CONN.

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# BRISTOL'S TEMPERATURE CONTROLLER

## MODEL 377

*For Ranges -30 to +800°F*



Fig. 2290

Model 377 Controller is shown here complete with 25-feet (standard length) of flexible connecting tube and Sensitive Bulb No. 3312. This bulb although closely coiled for illustrating purposes, is bendable, and when straightened out is 25-feet long. It is an Averaging-Bulb and is desirable to use in connection with atmospheric temperatures in rooms, ovens, kilns, etc. Other bulbs suitable for practically every requirement can also be furnished.

The Bristol's Temperature Controller described in this bulletin is a Thermostat Type of Thermometer, built for industrial use. The result of development extending

over many years, insuring accuracy in design and construction, thus making it dependable under all reasonable conditions.

### TEMPERATURE RANGE

The instrument is an Indicating Thermometer of the Gas Filled Type. It is suit-

able for installations within temperature ranges between -30 and +800° Fahrenheit.

### ADAPTABILITY

This Thermostat is adaptable for practically every kind of installation ever required of it. The Distance Type with flexible connecting tube between the sensitive bulb and the instrument, permits the bulb to be

installed several feet away, through partitions, inside ovens, in pipe lines, etc., which would otherwise be inaccessible. A wide choice of bulbs makes the range of applications even more flexible.

### OPERATION

The Sensitive Bulb is exposed to the temperature to be controlled. This bulb contains nitrogen gas the pressure of which varies in proportion to the temperature changes. The bulb is connected by a capillary tubing to an elongated Bourdon Tube Spring, wound in the form of a helix. Thus,

as the gas expands it generates a pressure which causes the spring to unwind. Attached to the spring is a shaft and pointer which indicates the temperature on the thermometer scale. The result is a Thermometer having a positively actuated pointer.

### ADJUSTABLE CONTACTS

On either side of the pointer are Adjustable Contacts which can be set at any temperature within the range of the scale. The pointer cannot pass either Contact without completing a circuit. If, for any reason, the temperature goes beyond the bounds of the

desired control, it makes no difference how high or low on the scale the indicating arm moves, the circuit through contacts continues, until the pointer passes in the opposite direction and releases it.

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
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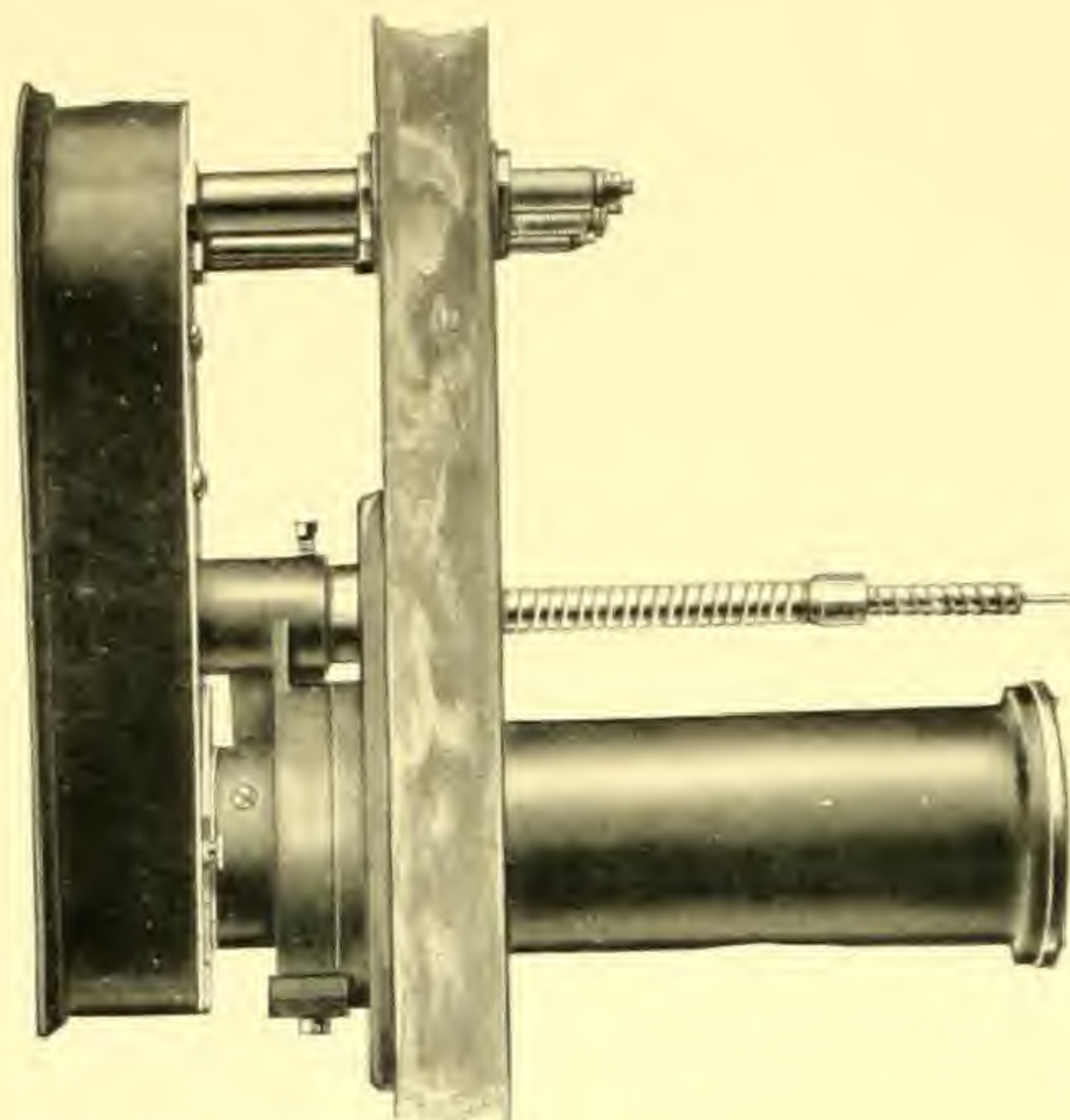


Fig. 2265

## FLUSH TYPE CONTROLLER

MODEL 377

This shows a sectional view of the Controller applied to a panel of switchboard where it is preferred not to have the instrument extend out beyond the switches, etc., mounted near it. The flexible connecting tube passes through the board and all electrical connections are made in the rear of the panel.

## ELECTRICAL CAPACITY OF CONTACT

The Contacts are made of the very best material for the purpose, and was determined upon after exhaustive experiments were conducted. Not less than 100,000 "makes" and "breaks" at the maximum load for which they are designed, may be expected before attention is necessary. To obtain the long-

est life possible of the contact, no one of the following maximum conditions should ever be exceeded.

Maximum Power — 50 Watts  
Maximum Current —  $\frac{1}{2}$  Ampere  
Maximum Voltage — 220 Volts

## ZERO ADJUSTER

A Zero Adjuster operated from the outside of case, is provided to reset the reading of the thermostat, when it is desired to make

it agree with other thermometers measuring the same temperature.

## FLEXIBLE CONNECTION

The standard length of connecting tube furnished to use with this Model 377 Controller is twenty-five feet. However, when required it can be supplied up to one-hundred feet long. Where longer lengths than

twenty-five feet are desired, information should be given in regard to the temperature changes which may occur along the connecting tube.

## ELECTRICAL INSULATION

All electrical connections and leads are amply insulated. In fact, each instrument is tested at 1200 volts, which is far in excess of the maximum voltage for which it may

ever be expected to carry. The equipment is also inspected and accepted by the Underwriters.

NOTE

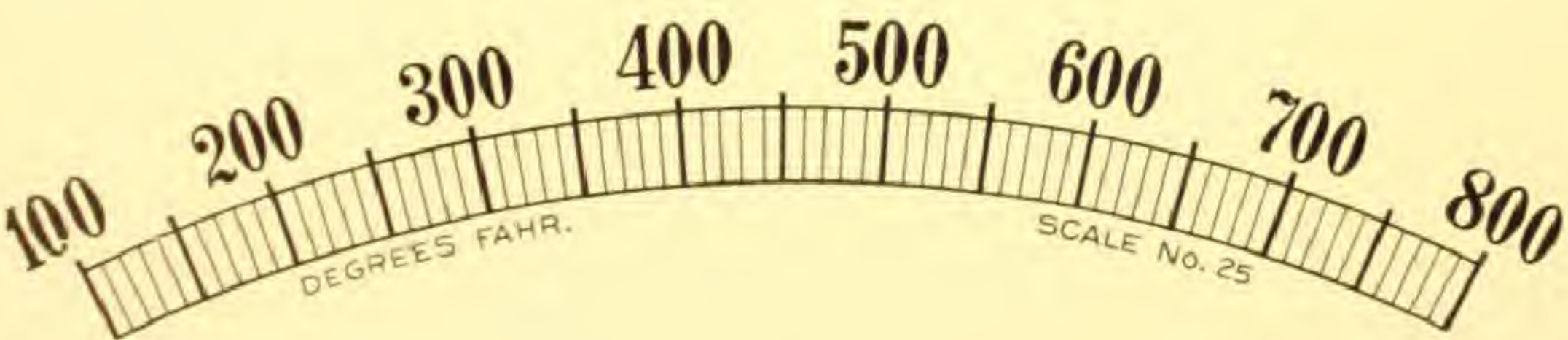
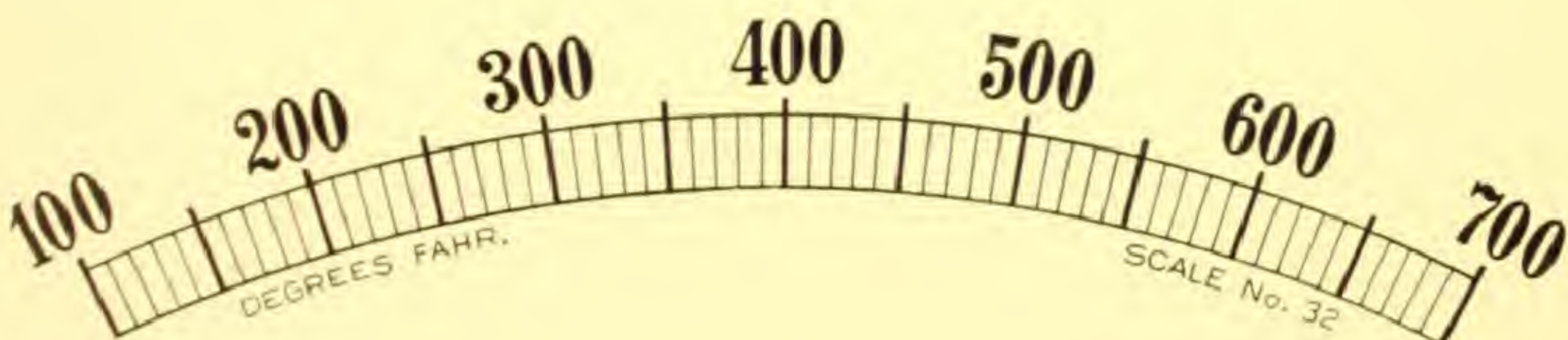
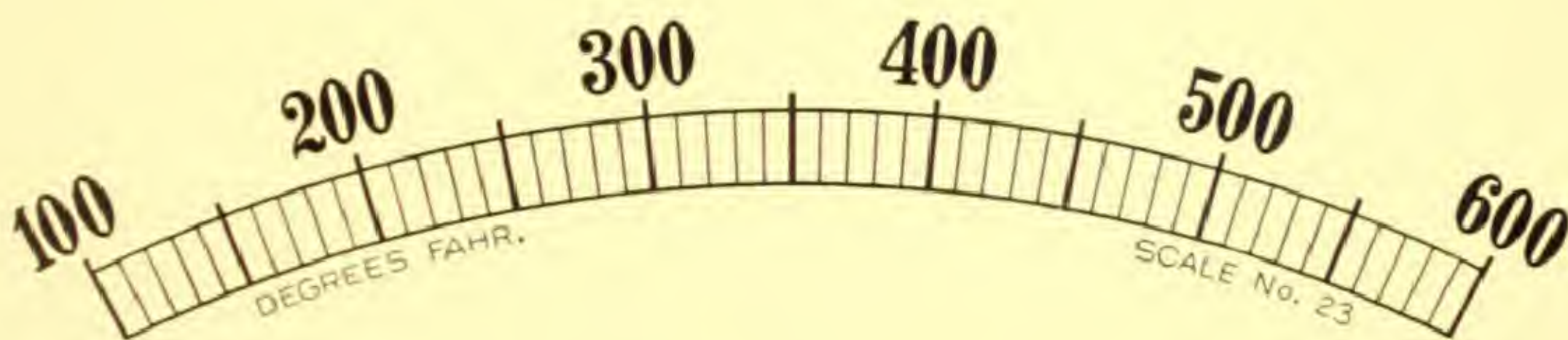
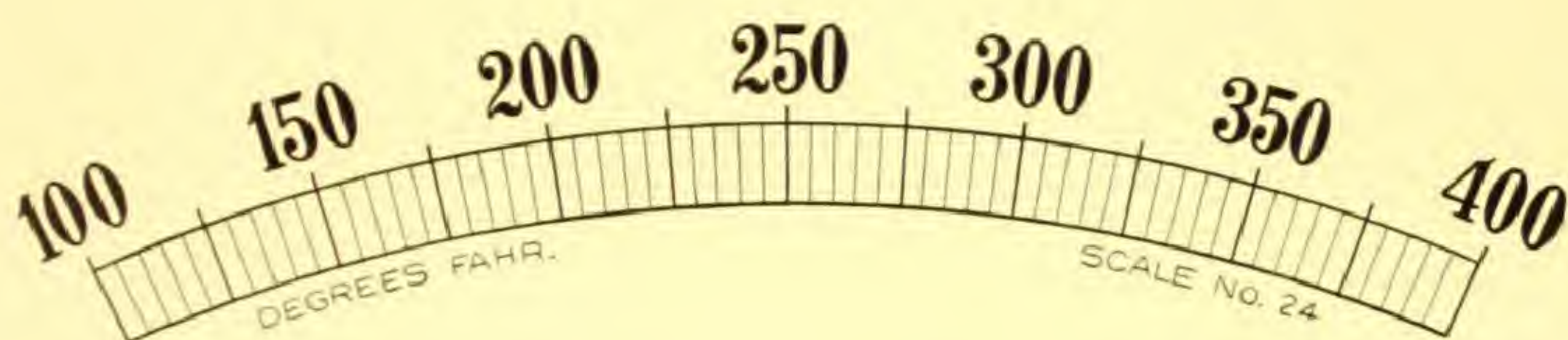


## TEMPERATURE CONTROLLER MODEL 377

### SCALES

Temperature Scales with white background and black lines and figures, are provided with all Model 377 Controllers. The scale is furnished principally to permit an accurate setting of the adjustable contacts to the control point. It, however, also serves

to show the cycle of temperature, and is very valuable for this purpose when a recording instrument is not also used. Several specimen scales (in actual size) are shown below.



NOTE: Scales reading in Degrees Centigrade are also furnished and are made interchangeable with the above.



TRADE MARK  
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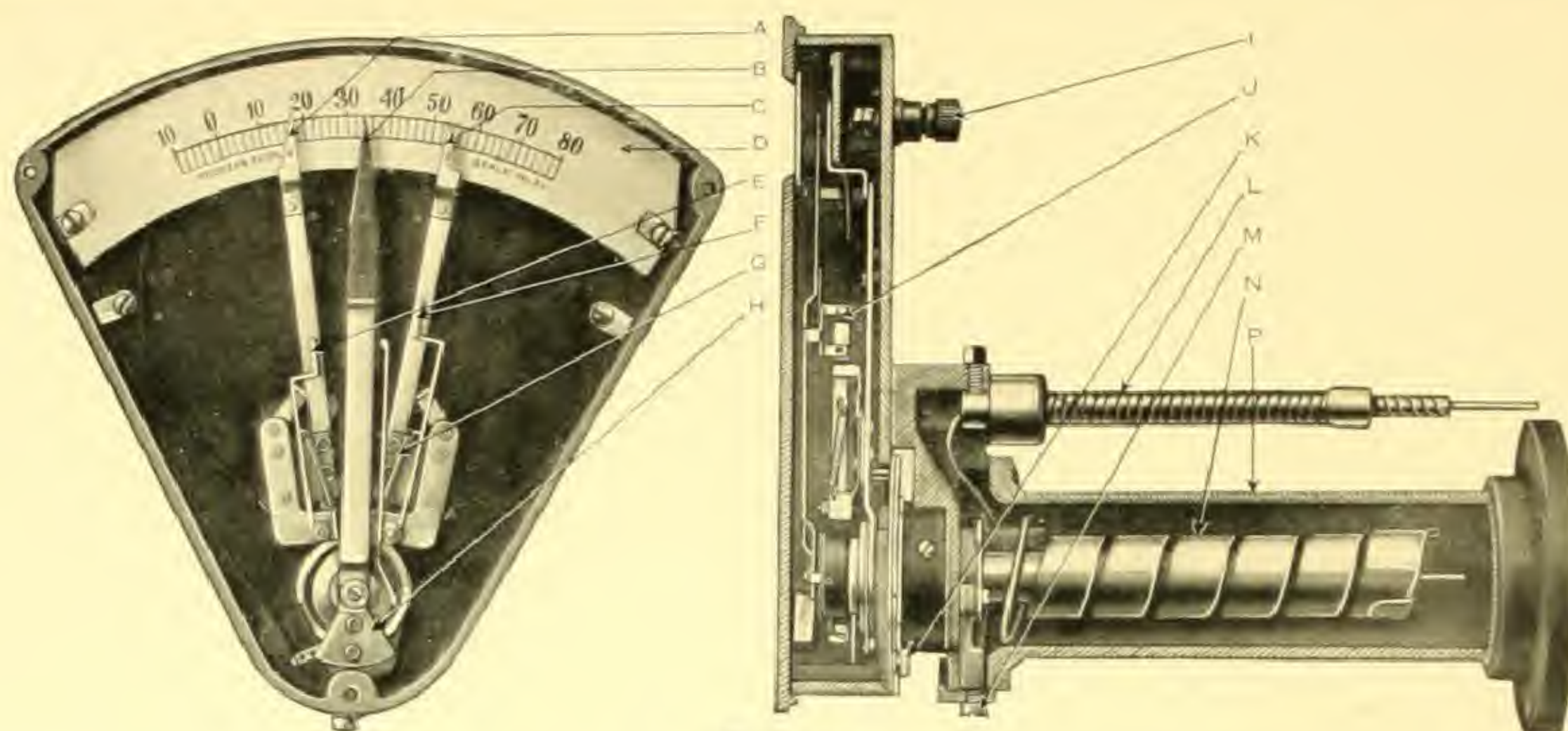


Fig. 2268

## DETAILS OF CONSTRUCTION OF THERMOSTAT MODEL 377

A—LOW ADJUSTABLE CONTACT ARM.  
B—INDICATING POINTER.  
C—HIGH ADJUSTABLE CONTACT ARM.  
D—SCALE PLATE.  
E—LOW ADJUSTABLE CONTACT.  
F—HIGH ADJUSTABLE CONTACT.  
G—CONTACT SPRING.  
H—POINTER COUNTERWEIGHT.  
I—BINDING POSTS.

J—INDICATING POINTER CONTACT.  
K—BUTTON FOR ADJUSTING CONTACT ARMS FROM OUTSIDE OF CASE.  
L—ARMORED CAPILLARY TUBING EXTENDING TO BULB.  
M—ZERO ADJUSTOR.  
N—SENSITIVE PRESSURE SPRING.  
P—PRESSURE SPRING HOUSING, ALSO FORMING BRACKET TO FASTEN INSTRUMENT TO WALL.

In Figure 2268 the adjustable contact arms are shown several degrees apart. Each of these arms can be set independently to any point on the scale, and when set close together the indicating pointer moves about

$\frac{1}{32}$  of an inch to leave one contact and touch the other. The indicating pointer and each of the adjustable contact arms are electrically connected to binding post on the rear of the case.

## SENSITIVE BULB

To accommodate the Controller for various kinds of applications several styles of Sensitive Bulbs are available. Any Bulb shown

in The Bristol Company Catalog No. 1302 can be furnished with Controller Model 377.

## SOME PRACTICAL USES OF CONTROLLER

Some of the uses for which the controller is adapted are:

Ringling Alarm Bells—Lighting Lamp Banks for Signal Lights—Lighting Three Light Control Signal System—Operating Relays for Magnet Switch—Operating

Controller Valves for Heating Systems, including Bristol-Fuller Controller Valves and Bristol Solenoid Valves—Operating Bristol's Electric Time or Operation Recorders.

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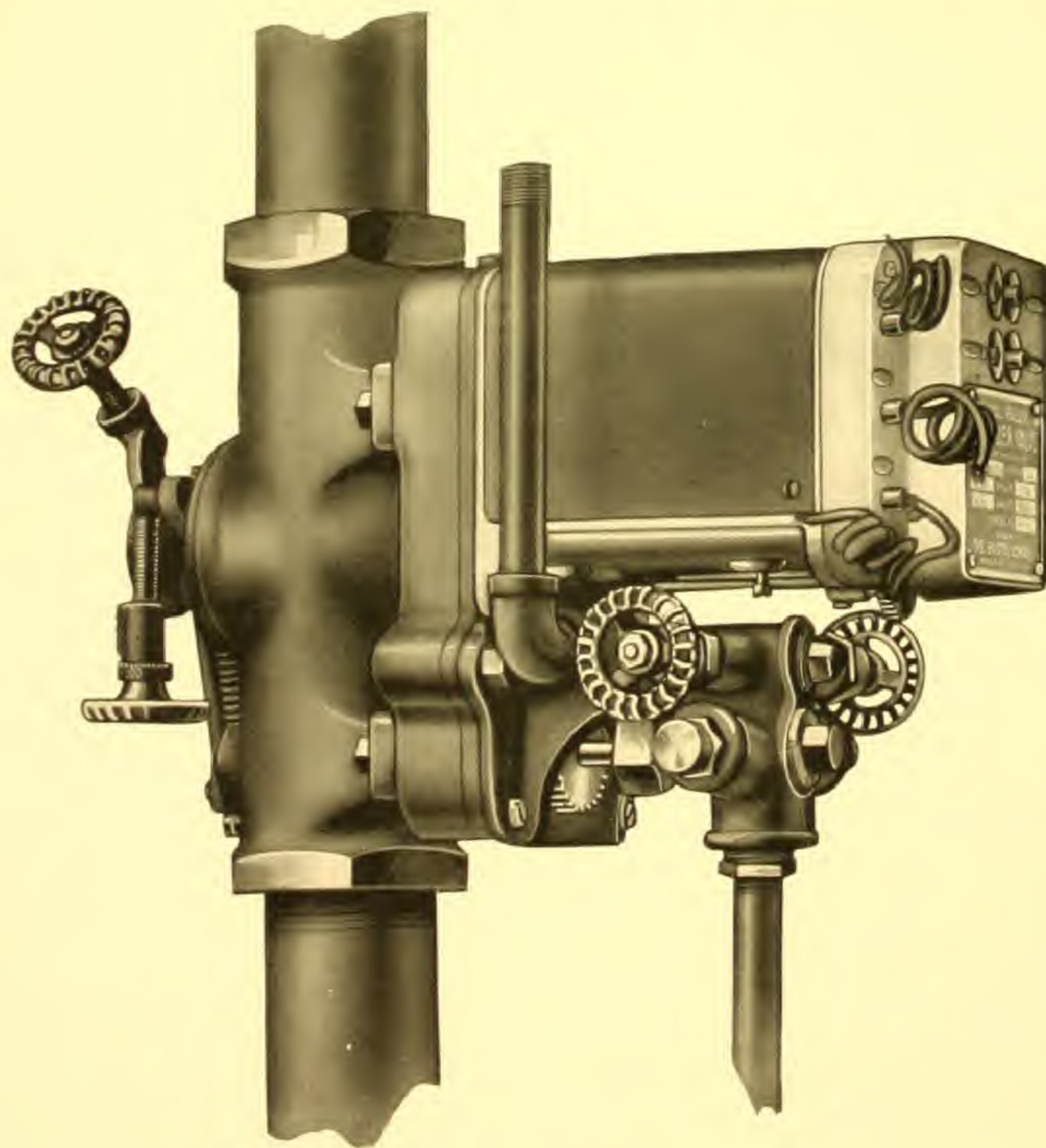
Boston New York Philadelphia Birmingham Pittsburgh Detroit Chicago St. Louis Denver San Francisco

BULLETIN

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No. 345

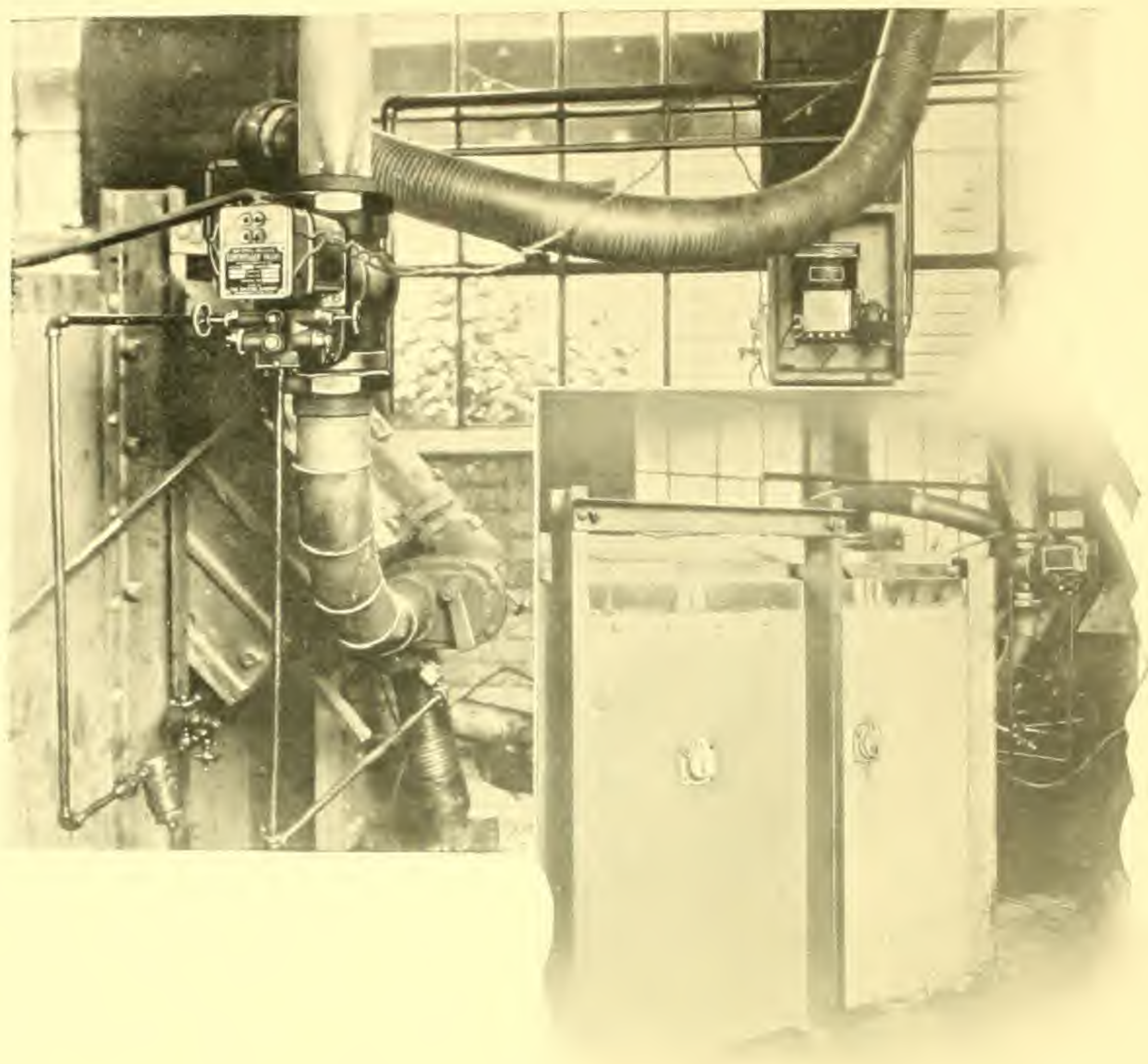
## BRISTOL'S MOTOR OPERATED CONTROLLER VALVE



ELECTRICITY

MOTION, ETC.





### INSTALLATION OF BRISTOL'S MOTOR OPERATED CONTROLLER VALVE FOR AIR AND OIL

On an oil burning Calorizing Furnace made by Mahr Co., Bristol's Pyrometer Regulator and Bristol's Motor Operated Controller Valves are automatically controlling the temperature to within plus or minus 3 or 4 degrees.

The fact that the same results can be repeated day after day insures a uniform product without loss from wrong heat treating.





## INSTALLATION OF BRISTOL'S MOTOR OPERATED CONTROLLER VALVE FOR AIR AND GAS

To the complete satisfaction of Partridge and Anderson, Chicago, the temperatures on their electrotyping pots are being automatically maintained at a constant temperature with Bristol's Pyrometer Regulator in connection with Bristol's Motor Operated Controller Valves.

The Pyrometer Regulator is located on the wall at the left of the door, while the Bristol's Motor Operated Controller Valves are installed in the air and gas lines near the electrotpe pot.

**INSTRUMENTAL**

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ELECTRICITY



## INTRODUCTION

### Development of Temperature Control Apparatus

The tremendous influence which heat has on the usefulness and durability of hundreds, yes, thousands of manufactured articles, is the reason why exhaustive study has been given to the subject of temperature control. For more than thirty-five years The Bristol Company has been designing and building instruments for automatically recording temperatures, and in line with this, for many years has been making complete temperature control equipment, applied to oil, gas and electrically heated ovens, furnaces, etc. Hundreds of these have been installed and have proved to be very satisfactory, but constant research and experimenting has developed the Bristol's Motor Operated Controller Valve, which is a great step in advance of anything heretofore available. It provides closer adjustment and is more dependable in every way.

### Must First Be Capable of Hand Control

Of course, good results from any automatic heat controlling apparatus is not to be expected, unless the heat treating equipment can be operated by hand. We make this statement because it is a fact that oftentimes inquiries are received for automatic control apparatus to be used in connection with ovens and furnaces which are misfits, that is, they are being used for classes of work for which they are not intended, and satisfactory results are impossible. Even with temperature control outfit installed, the skill and judgment of the operator is still needed, especially if the load on the furnace is varied and if different kinds of work are treated in the same furnace. Good results can only be obtained by the proper co-ordination of all factors involved.

### Applications

Bristol's Motor Operated Controller Valves are used with automatic temperature controlling apparatus to control the flow of air and gas, air and oil, steam and oil; also for air, gas, steam, oil and other liquids. In the limitations of this bulletin, it is impossible to show all the variations for which this equipment can be supplied. Only a few of these are shown in order to give a general idea of what the equipment is like. In the industrial field there are scarcely two installations alike in detail,

however, suitable Bristol's Motor Operated Controller Valves can be furnished for practically every installation encountered. Therefore, if the equipments described in this bulletin do not exactly fill your needs, do not assume that Bristol's Motor Operated Controller Valves are not suitable for your installation. Instead, tell us what your requirements are.

### Operation

Both the fuel and air valves are operated by one electric motor. When using the valves for controlling a temperature, both the valves are first adjusted to a low setting, giving a flame of perfect combustion, but too low to bring furnace up to desired temperature. If an automatic controlling instrument is used in connection with valves to measure temperature of furnace, when set to temperature wanted, a contact will be made which will start the motor. When the valve is opened the motor stops. With both valves in this position, they may be adjusted to give a high flame of perfect combustion, which will bring temperature of furnace slightly above the temperature wanted, then as soon as the furnace has reached the temperature higher than desired, the instrument will make contact, thus operating the motor and close the valve to the low flame. All adjustments of the valves are made independently, and thus in no way can one adjustment upset any other. When a sensitive controlling instrument is used, and the high and low flames are correct, it has been found that the furnace assumes the temperature desired.

### Timing of Fuel and Air

In order not to impair the quality of the flame during the time when changing from low to high, or high to low, it is essential that the valves are properly timed. This is taken care of when the valves are assembled, and can not change so long as the valve units are assembled to the power units. As an example, when an oil and air valve are used, the oil valve operates slightly ahead of the air valve when flame is changing from high to low. In this way the oil will be drained from the pipe and there will be no excess for low flame. However, when flame is changing from low to high, the air turns on ahead of oil in order that a greater flow of oil will be sure to have sufficient air to carry it into the combustion chamber.



## Parts of Construction

The power units of Bristol's Motor Operated Controller Valves, consists of three parts—the Gear Box, the Motor Box and the Switch. These parts are bolted together so that replacement of any one of these may be readily made.

### Gear Box

The gears used to reduce speed of the motor are housed in a cast iron box. These gears are of the best type obtainable and machined to very accurate limits. The parts run steel to bronze, or steel to cast iron, as closely as good machine practice will allow. The two halves of the gear box are machined so that it is practically tight, and will hold sufficient oil to lubricate gears for six months. An oil hole with screw cap is provided on top of box.

### Motor

A standard make of motor is used, and can be furnished in practically all commercial voltage, including 110 volts, 60 cycles; 110 volts, 25 cycles; 220 volts, 60 cycles; 110 volts D.C. When 220 volts D. C. is used, an external resistance is furnished. The motor is entirely enclosed in a motor box which also serves as bracket for switch. This motor box completely protects the motor from dust, and also is provided with oilers sufficiently large to contain oil for one year.

### Switch

The valves are opened and closed by crank motions, thus the motor is not reversed, but is stopped at the end of the stroke of the crank. In order to stop the motor at the high and low valve adjustments, a control switch, operated by a cam turned by the motor, is opened. This switch has two sets of contacts, one in the circuit of high contact of control system, and the other in circuit of the low contact. When the cam breaks one circuit, it makes the other. This cam and switch are housed in an aluminum case. The case also contains push-button switches, which may be used to operate the valve electrically, without the controlling instrument. Large Tungsten points are used in the control switches to

insure good contact and long life. Long pig-tails are also provided to facilitate connecting valves to controlling circuit.

## Position of Valves

Bristol's Motor Operated Controller Valves are designed to operate in the position in which they are shown in the illustrations in this bulletin, but they may be operated in any position in which the name plate is in a vertical plane and not reading upside down.

## Results

The use of Automatic Temperature Control Equipment suited to the work in hand and properly installed, will result in—

- (1) Better quality and uniform product.
- (2) Increase in production.
- (3) A decrease in repairs on the furnace.
- (4) No waste in fuel.

## Automatic Control Instrument

This bulletin is principally devoted to the Bristol's Motor Operated Controller Valve. However, in order to secure positive automatic control of temperatures, reliable control instruments are necessary. The Bristol Automatic Control Instruments are divided into two classes—those suitable for controlling temperatures up to 800°F. and those used for temperatures between 800°F. and 3000°F. These instruments are illustrated and more fully described on Pages 12 and 13.

## Recording Instruments

To check accuracy of automatic temperature control, many times a recording instrument is installed in connection with the furnace or oven, which makes an automatic and continuous record on the chart of the exact temperatures maintained. Such a record shows conclusively just how close the temperatures have been held. And when used in connection with any particular piece of work, can be used as a pattern to follow when it is required to duplicate. For this purpose Bristol's Recording Thermometers and Pyrometers are used; the Thermometers for temperatures up to 800°F., and the Pyrometers for temperatures up to 3000°F.



## BRISTOL'S MOTOR OPERATED CONTROLLER VALVE FOR AIR AND OIL

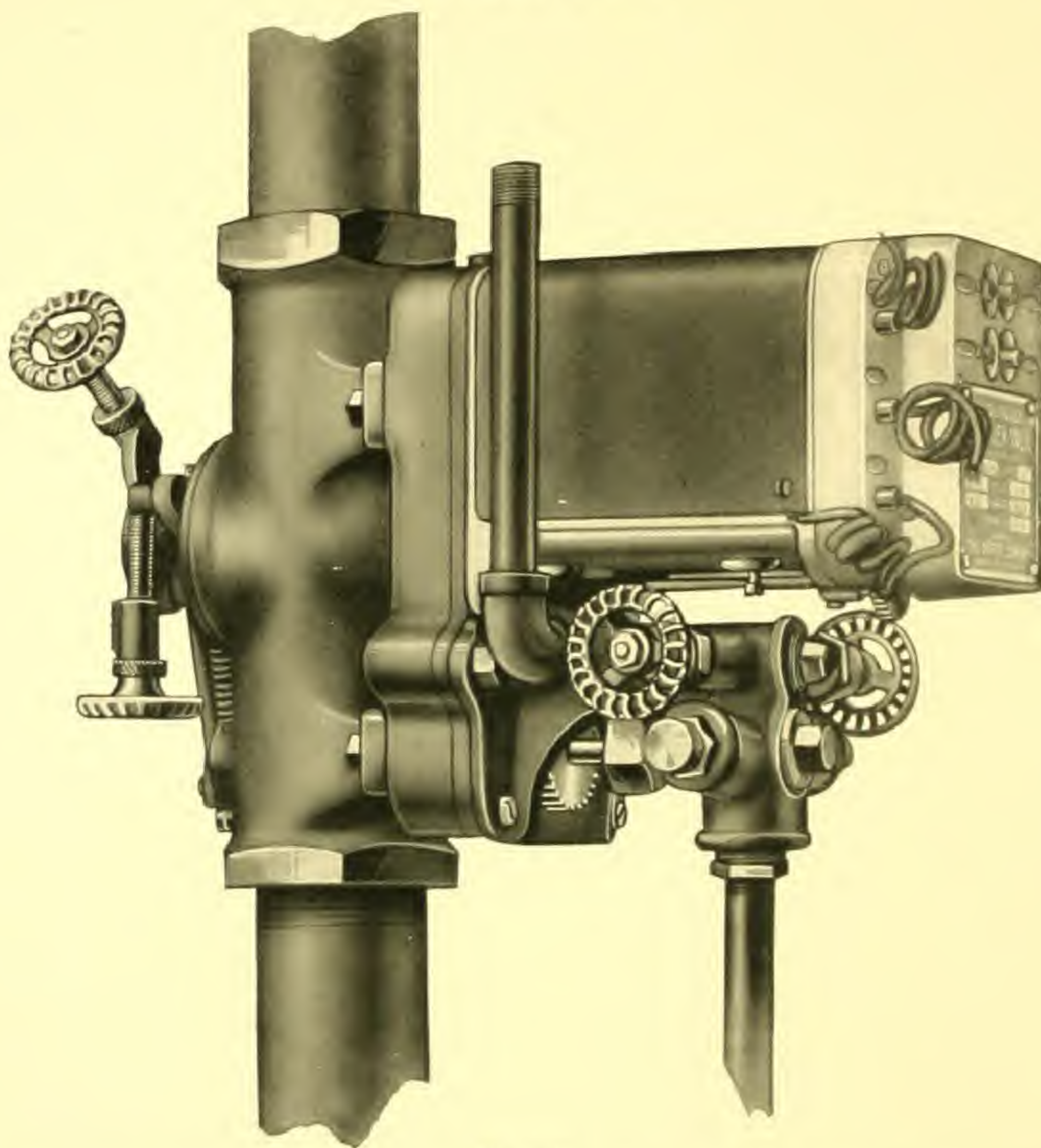


Fig. 2057

The Air Valve is a butterfly or damper design and suitable for lower pressures only, of not over two-pounds per square inch. Arranged for installation in vertical position in two-inch pipe.

The Oil Valve is for vertical installation in  $\frac{1}{2}$ -inch pipe and may be bushed to smaller pipe sizes. There are two passages, one for the high flame, and the other for the low flame adjustment. A cam operated by the motor, opens a poppet valve in one passage and closes a poppet valve in the other, when

the flame changes from one intensity to the other. This arrangement permits a very fine adjustment to be made.

The valve housing is cast bronze. The cam and poppet valves are of hardened steel ground to size. A large stuffing box is provided in the shaft carrying the cam and ample room is allowed for repacking.

The oil ducts are large and can be easily cleaned. It is an easy matter to open either valve for cleaning should any dirt settle in its passages and interfere with the flow.

Prices quoted on request



## BRISTOL'S MOTOR OPERATED CONTROLLER VALVE

FOR AIR AND GAS

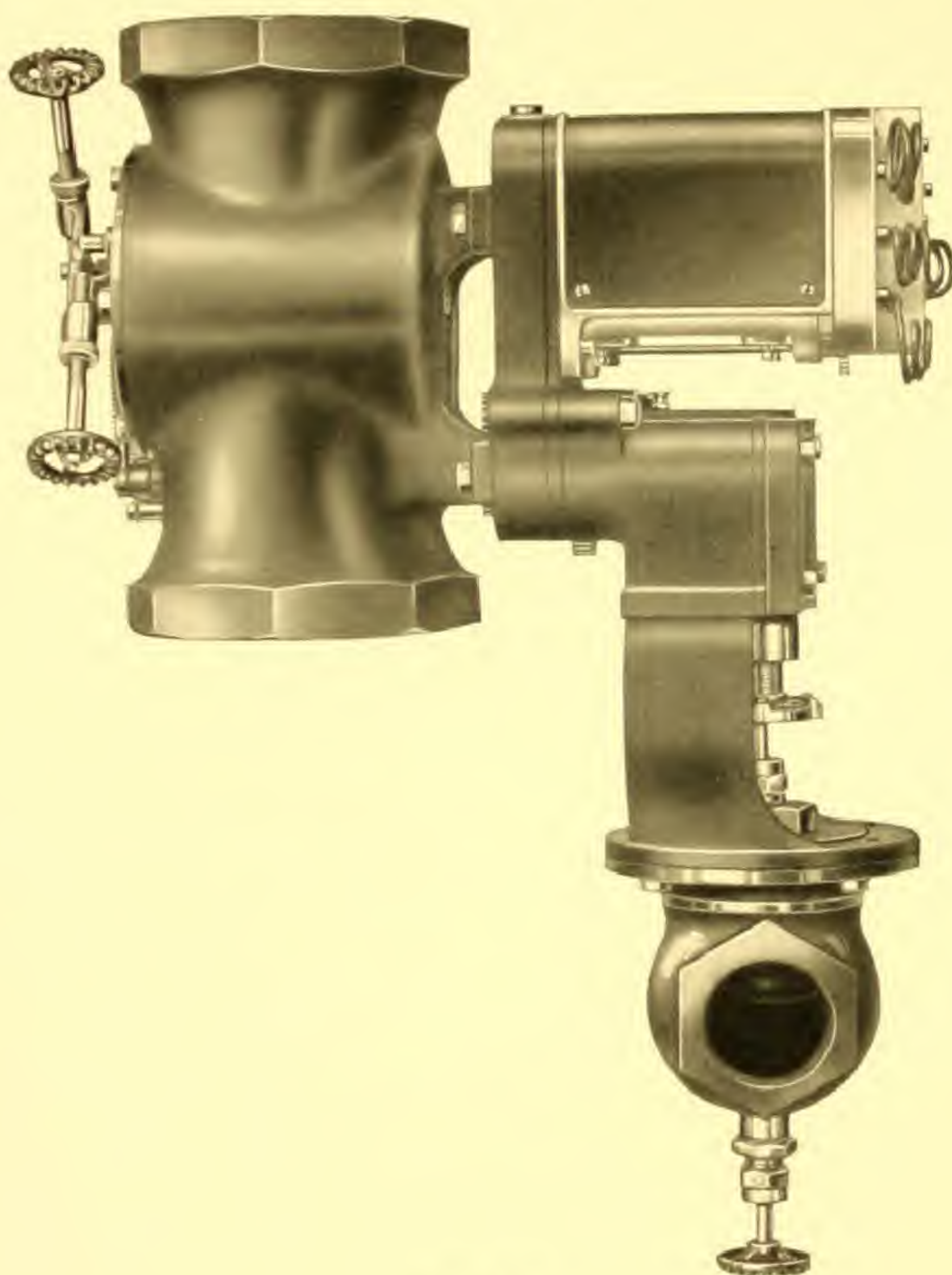


Fig. 2053

The above valves are for Air and Gas.

The Air Valve is the butterfly design, for low air pressures only, not exceeding two pounds per square inch, (see page 8 for high pressure valve.) For installation in vertical position in 4-inch size pipe.

Gas Valve, is a globe type—suitable for all commercial gas pressures. For installation

in horizontal position in 2-inch pipe. The valve is opened by a crank in the bracket-housing and closed by a coil-spring within the valve body.

High and low settings are made by handwheels, as shown in the illustration.

Great care has been given to the design of stuffing boxes and ample room is provided for repacking.

Use outline on page 15 when writing for quotation

ELECTRICITY

MOTION, ETC.



## BRISTOL'S MOTOR OPERATED CONTROLLER VALVE

FOR AIR AND GAS

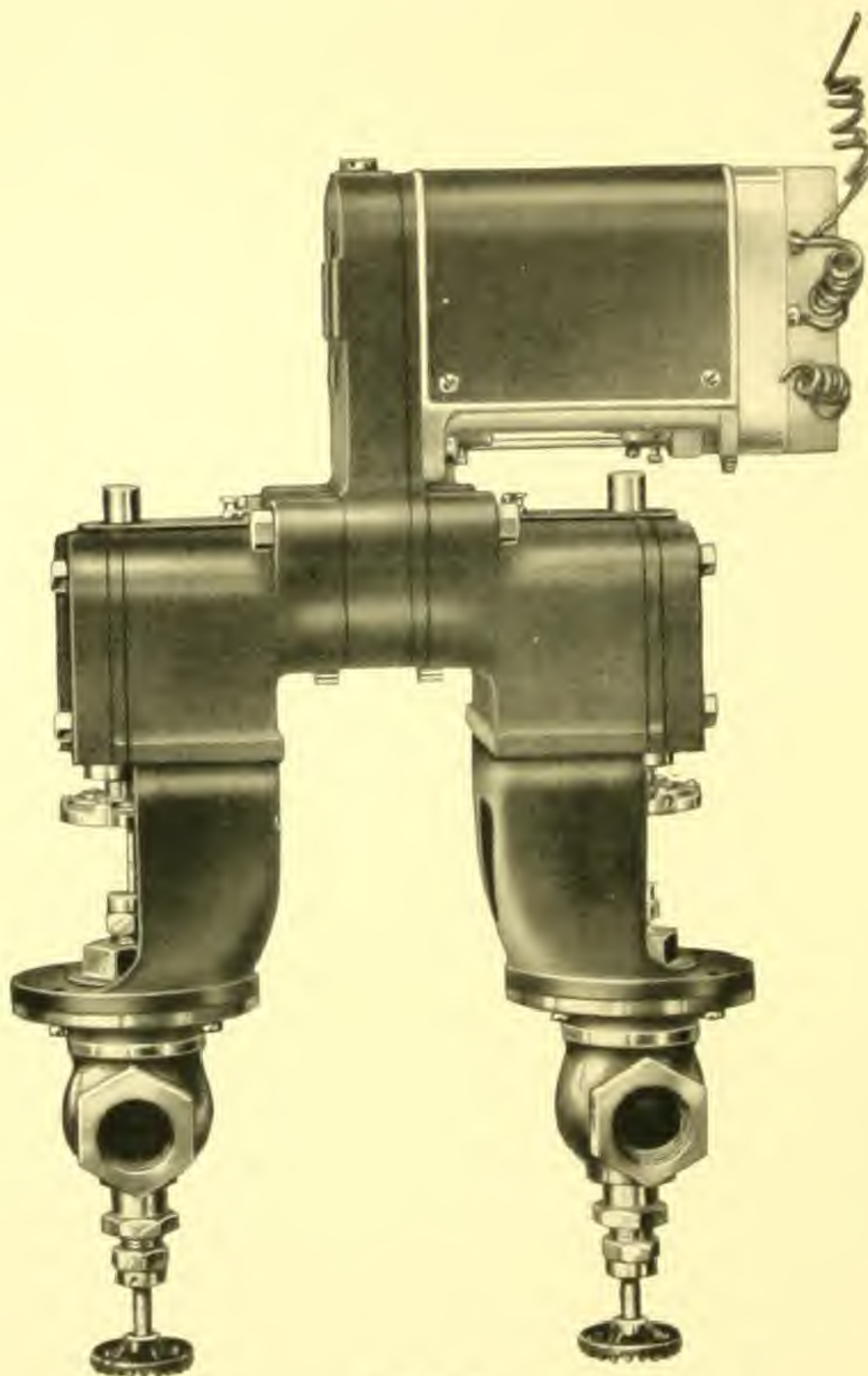


Fig. 2055

These controller valves are for air and gas where feed pipes are in horizontal position. Particularly for installations on higher air pressures, i. e., above two pounds and not exceeding 100-pounds per square inch. Can

be furnished for all pipe sizes up to 4-inches.

Both the Air and Gas Valves are of the globe type, same as the gas valve fully described on page 7. Both valves operate from the one motor.

Prices quoted on request

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## BRISTOL'S MOTOR OPERATED CONTROLLER VALVE

FOR AIR, GAS, WATER AND STEAM

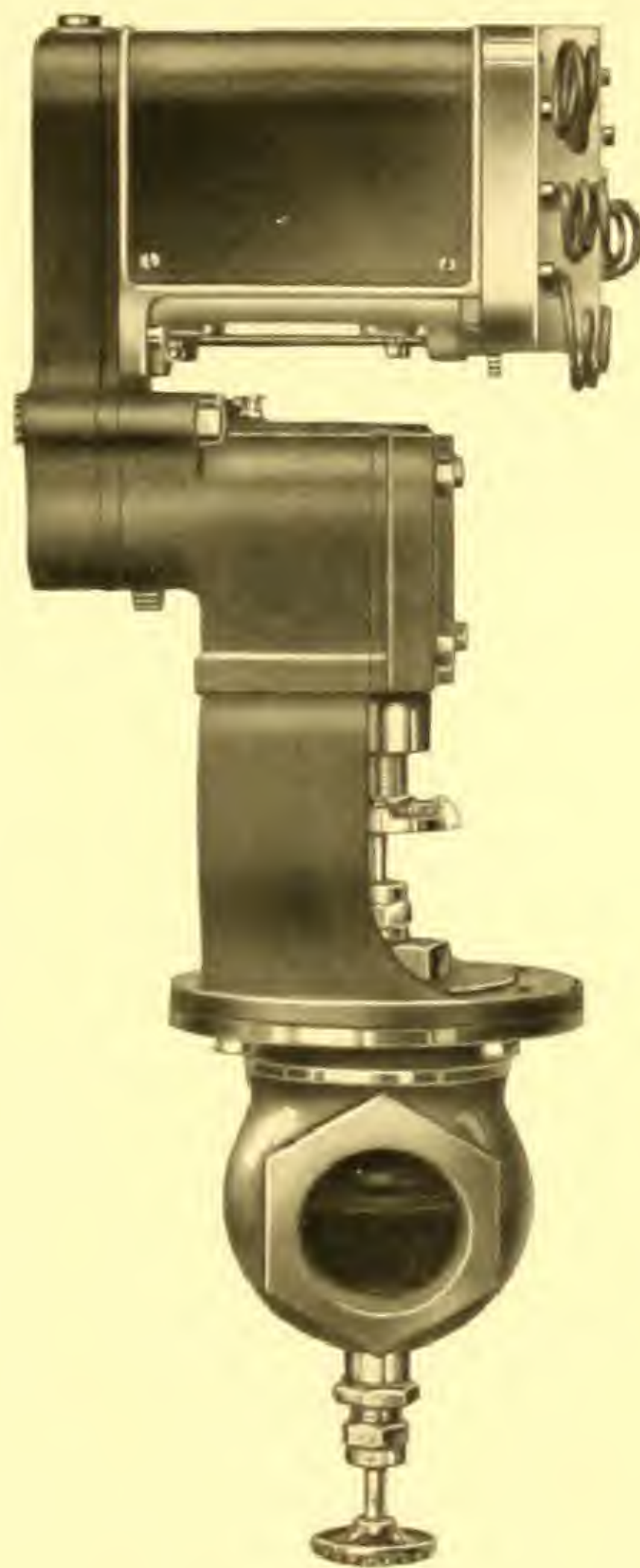


Fig. 2059

This style of valve is suitable for air, gas, water and steam, also pre-mixed gas and air, for pressures up to 100-pounds per square inch. Furnished in all pipe sizes up to 4-inches for use on pipe line in horizontal position.

When used for air, gas or water, a globe type of valve is employed, but for steam application, a double-seated valve is furnished. This double-seated valve can be used on

pressures as high as 150-pounds per square inch in sizes up to 1½-inch.

For applications where automatic control is not necessary, this single valve can be used for remote control, by running wires to the motor box and installing a two-way hand-switch. This long distance control has great advantages for some applications.

Use outline on page 15 when writing for quotation

ELECTRICITY

MOTION, ETC.



## BRISTOL'S MOTOR OPERATED CONTROLLER VALVE

FOR AIR AND GAS

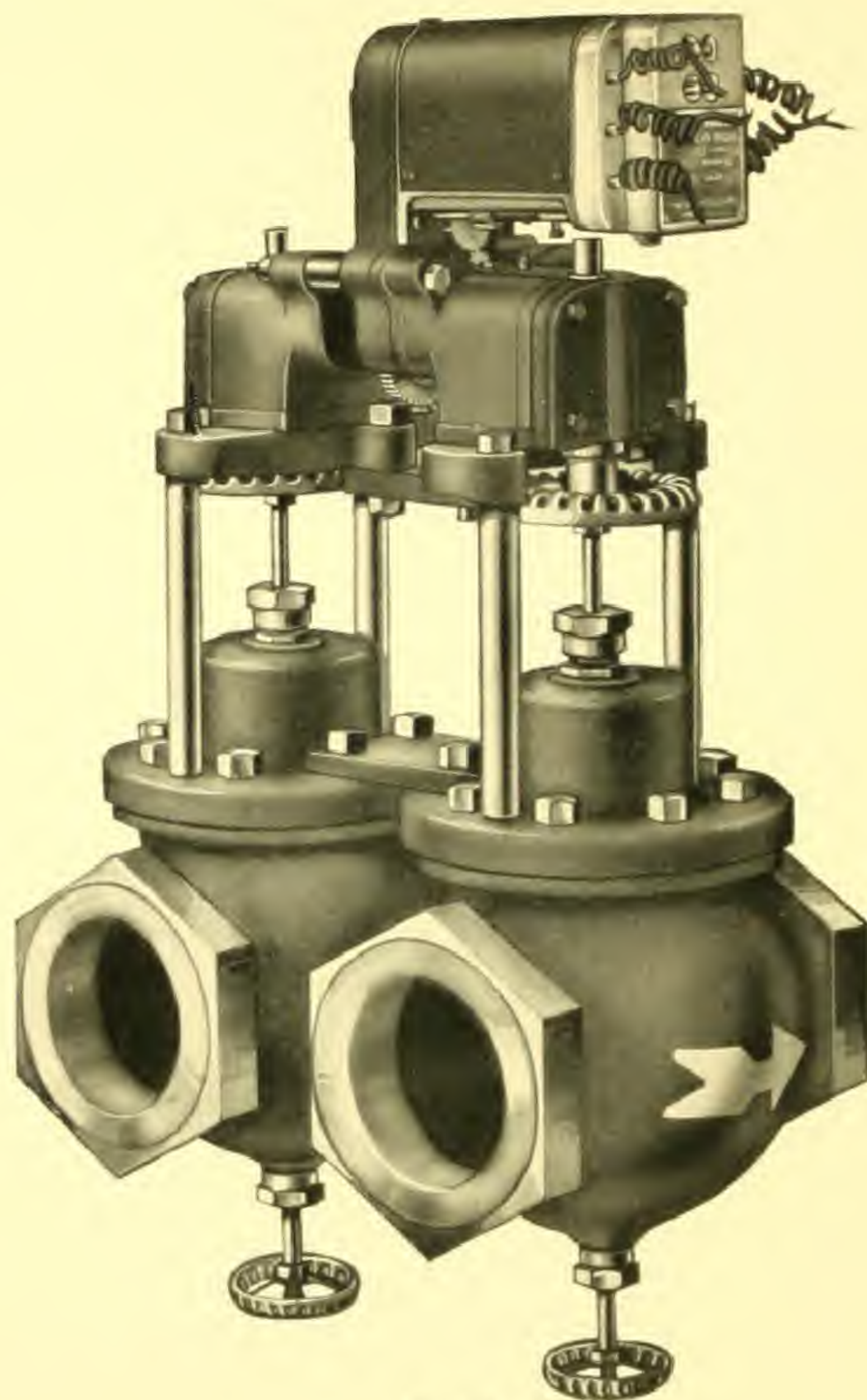


Fig. 2051

This is a larger valve than others shown in this bulletin. It is designed for installation in horizontal position in 4-inch pipe line for pressure not more than 10-pounds per square inch.

Both the air and gas valves are globe type, and both operate from the one motor.

This valve is so constructed that the pipe

strains can in no way effect the operating mechanism.

The hand wheels are large and are in the natural position for opening and closing valves by hand.

It is possible to remove the valve discs for cleaning without removing valve from pipe line.

Prices quoted on request



## BRISTOL'S SAFETY STOP VALVE

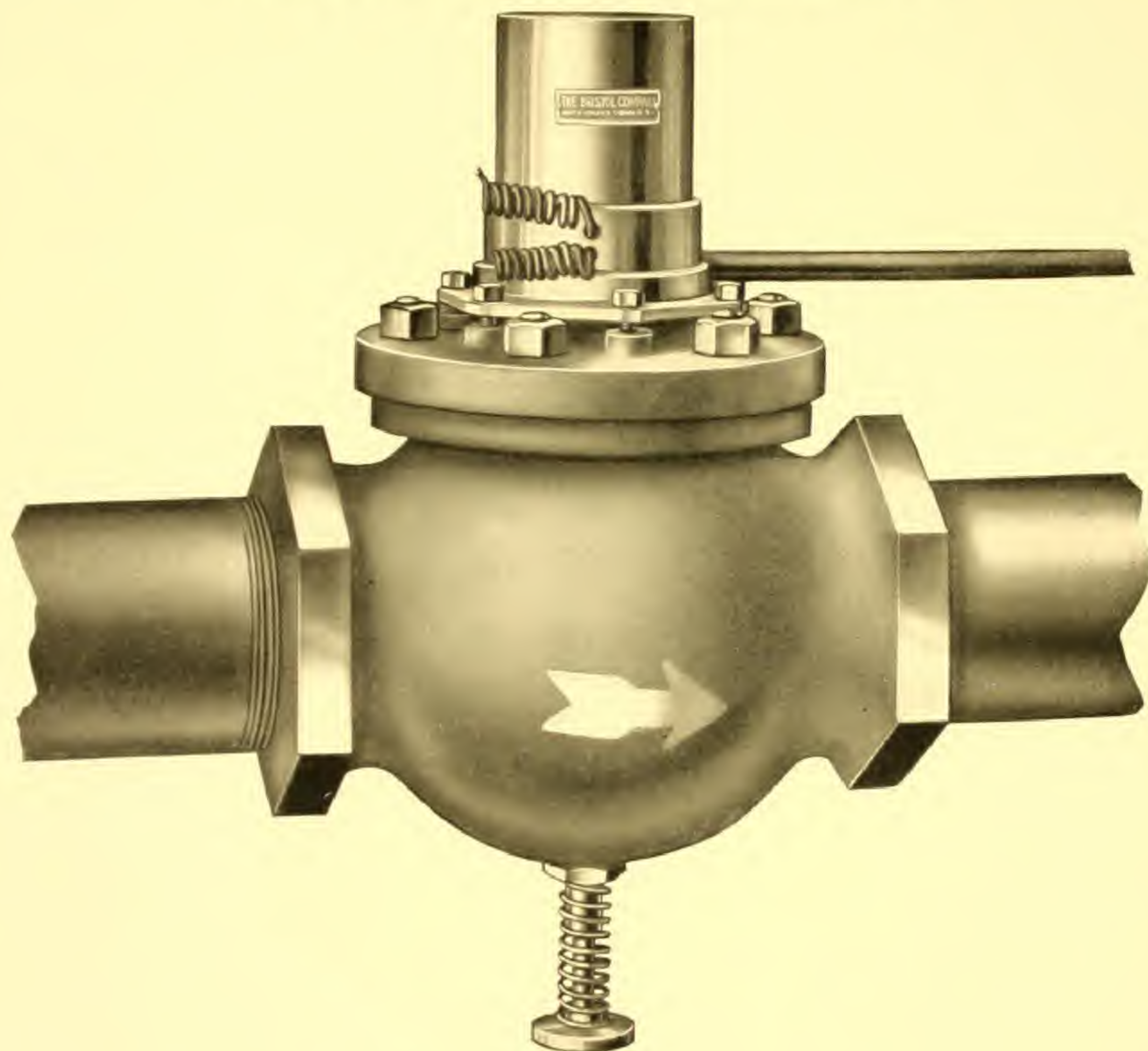


Fig. 2061

In connection with automatic control it is essential to have a safety device to shut off fuel in case of failure of electric power or air pressure.

Bristol's Safety Stop Valve has been designed to install in fuel supply line in connection with furnace, ovens, etc., to automatically stop the flow of fuel when either the electric power or air supplying the furnace is interrupted. Also, when a fuel like gas is used alone, should the gas pressure fail the valve will close.

Should the electric power, fuel or air be turned on, the valve will not open, but remain closed until opened by the operator. Thus, the fuel can in no way escape into the furnace that has not been lighted, without the will of the operator.

For an installation where there are several control systems, one Safety Stop Valve in the main supply line will take care of them all.

The Safety Stop Valve can be furnished in sizes suitable for use in 1-inch, 2-inch, 3-inch and 4-inch pipe line.

Use outline on page 15 when writing for quotation

ELECTRICITY

MOTION, ETC.



## BRISTOL'S TEMPERATURE CONTROLLER MODEL No. 377

FOR TEMPERATURES UP TO 800°F.



Fig. 2577

The above model of temperature control instrument is used to secure and maintain automatic control of temperatures up to 800°F.

The instrument is a thermostat, operated by the expansion of a gas contained in the sensitive bulb, and transmitted to the instrument through a capillary tubing.

In use, the sensitive bulb is installed in the oven, furnace, etc., where it is desired to control the temperatures. The exact temperature surrounding this bulb is measured and indicated at the instrument.

The instrument is equipped with an adjustable contactor which may be adjusted to break contact at any point on the scale at which it is desired to regulate the temperature. As the temperature falls or rises the indicating arm closes or opens the electrical circuit by coming in contact or moving away from the adjustable contactor arm. The closing or

opening of the electrical circuit opens or closes the electrically operated valves or switches, causing an increase or decrease in the flow of the heating element. This principle may be applied to furnaces or ovens heated by gas, oil or electricity.

The electrical contactors of this instrument are capable of carrying 25 watts at a potential not above 220 volts.

The pointer on the scale of the instrument shows at all times just what temperatures are being maintained in the furnace, oven, etc. In this way, it is possible to know how long it takes to reach the required temperature after the contactor has been set at the required point, and also shows just how close the regulation is being maintained.

There is nothing particularly complicated about this equipment, and it may be readily installed with the assistance of the complete directions which are furnished.

Prices quoted on request

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lighting



## BRISTOL'S TEMPERATURE CONTROLLER MODEL No. 479

FOR TEMPERATURES FROM 800°F TO 3000°F.



Fig. 2481

For automatic temperature control work between 800°F and 3000°F, this Pyrometer Controller is used.

The instrument is a high resistance Pyrometer, operating on the Thermo-Electric principle. It functions as a Thermostat, and is equipped with adjustable contactor, which can be set at any point on the scale where it is desired to hold the temperature. The fire-end (or Thermo-Couple) is installed in the furnace, oven, or other apparatus of which it is required to control the temperature. As the temperature of the fire-end rises or falls, the indicating arm makes an electric contact. This automatically opens or closes electrically operated valves or relay, thus decreasing or increasing the heat medium, which results in holding the temperature at a very constant degree.

An electric motor is used to furnish power for the controller instrument. This supplies a very reliable and powerful method of drive. The motor is operated by current from the lighting circuit.

Although the indicating scale on the controller instrument shows just how close regulation is being maintained, many times it is desired to have a permanent record of the entire temperature run, and for this purpose a Recording Pyrometer can be furnished to use in connection with controller equipment. The Recording Pyrometer Instrument may be located at some distance from the controller apparatus, for instance, in the superintendent's office. The continuous chart record shows beyond dispute, just how close the temperature is being held. Such a record also furnishes very valuable information for duplicating orders, and helps to settle disputes.

A very important feature in Bristol's Pyrometer Controller is the patented Automatic Internal Cold-End Compensator which is used, and makes it possible to accomplish satisfactory control of temperature without any consideration for Cold-End errors.

Use outline on page 15 when writing for quotation



## BRISTOL'S RECORDING PYROMETER, HIGH RESISTANCE SMOKED CHART MODEL 437



In connection with automatic temperature control equipment, very often a Recording Instrument is also installed. Such an instrument automatically records the temperatures in the ovens, furnaces, etc., and provides a positive proof of how close the regulation is being maintained.

For every Bristol Automatic Temperature Control Equipment there is a suitable corresponding recording instrument. For temperatures up to 800°F., Recording Thermometers are used; temperatures from 800°F. to 3000°F., Recording Pyrometers.

The instrument illustrated here is a Bristol's Pyrometer Model No. 437, using round chart. Such an equipment will furnish a continuous record of temperatures for twenty-four hours duration. These Pyrome-

ters operate on the Thermo-Electric principle, and are equipped with high resistance millivoltmeter movement.

When it is desired to have continuous records of longer time than twenty-four hours, a Pyrometer using strip type charts can be furnished, which provides a continuous record of forty-five days.

A very important feature of all Bristol's Pyrometers is the Automatic Internal Cold-End Compensator, which automatically makes correction for changes in cold-end temperatures, always encountered in Thermo-Electric type of instrument. With this automatic compensator, the instrument reads correctly at all times without taking into consideration Cold-End errors.

Prices quoted on request



### INFORMATION NECESSARY TO SUBMIT QUOTATION

In order to intelligently recommend the correct Bristol's Motor Operated Valves and Bristol Automatic Control Equipment for your use, it is necessary to have the fundamental information in regard to your requirements. If you will furnish the data as outlined below, it will enable us to make recommendations.

1. Kind of furnace or oven.
2. Approximate inside dimensions of furnace or oven.
3. Kind of fuel.
4. Number of burners.
5. Type of burners.
6. Size of pipes for fuel, air, etc.
7. Pressure of fuel, air, etc.
8. Voltage available to operate valve motor.
9. Is load on furnace controlled by operator?
10. Class of work to be treated.
11. Temperature to be controlled.
12. Maximum variations in control temperature expected.

A rough sketch of your present equipment and any details in regard to your particular needs will be of great assistance.

In addition to the engineering staff at our main office at Waterbury, we maintain ten district offices as listed on the back cover of this bulletin. At all of these places there are men with engineering training and experience to give you the assistance you may need.

ELECTRICITY

MOTION, ETC.



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## THE BRISTOL COMPANY

Main Office and Factory  
 WATERBURY, CONN., U. S. A.

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### THE MOST EXTENSIVE LINE OF RECORDING INSTRUMENTS IN THE WORLD

#### PRESSURE AND VACUUM

Bristol's Recording Pressure and Vacuum Gauges

#### LIQUID LEVEL

Bristol's Recording Water Level Gauges

Bristol-Derr Water Level Gauges for Steam Boilers

#### TEMPERATURE

Bristol's Class I Recording Thermometers

Bristol's Class II Recording Thermometers

Bristol's Class III Recording Thermometers

Wm. H. Bristol Indicating and Recording Electric Pyrometers

Bristol's Temperature Controllers

#### HUMIDITY

Recording Wet and Dry Bulb Thermometers

#### ELECTRICITY

Bristol's Recording Voltmeters

Bristol's Recording Ammeters

Bristol's Recording Wattmeters

Wm. H. Bristol Recording Milli Voltmeters

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#### TIME

Bristol's Electric Time Recorders

#### MOTION

Bristol's Mechanical Time Recorders

#### SPEED

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Bristol-Durand Radii Averaging Instruments

Gaugeboard Clocks

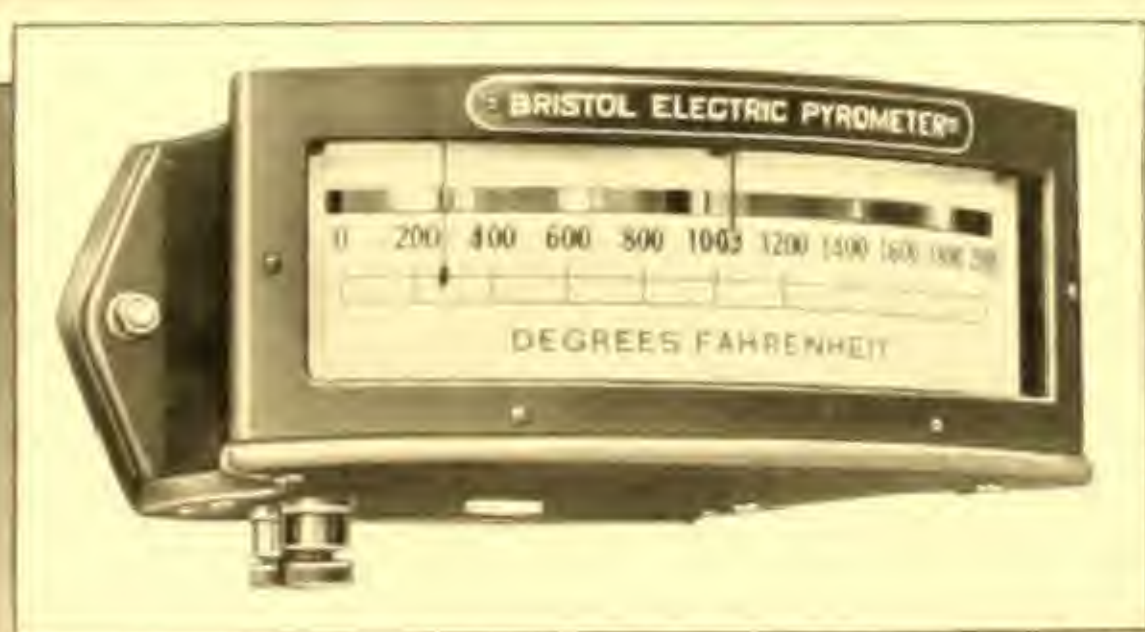
Bristol Engine Counters

Bristol Revolution Counters

Bristol Patent Safety Set Screws

**Bristol's Patent Steel Belt Lacing—The Perfect Fastener for All Kinds of Belts**





Individuals

[illegible]

ELECTRICITY

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## LOW RESISTANCE PYROMETER

### Interior View

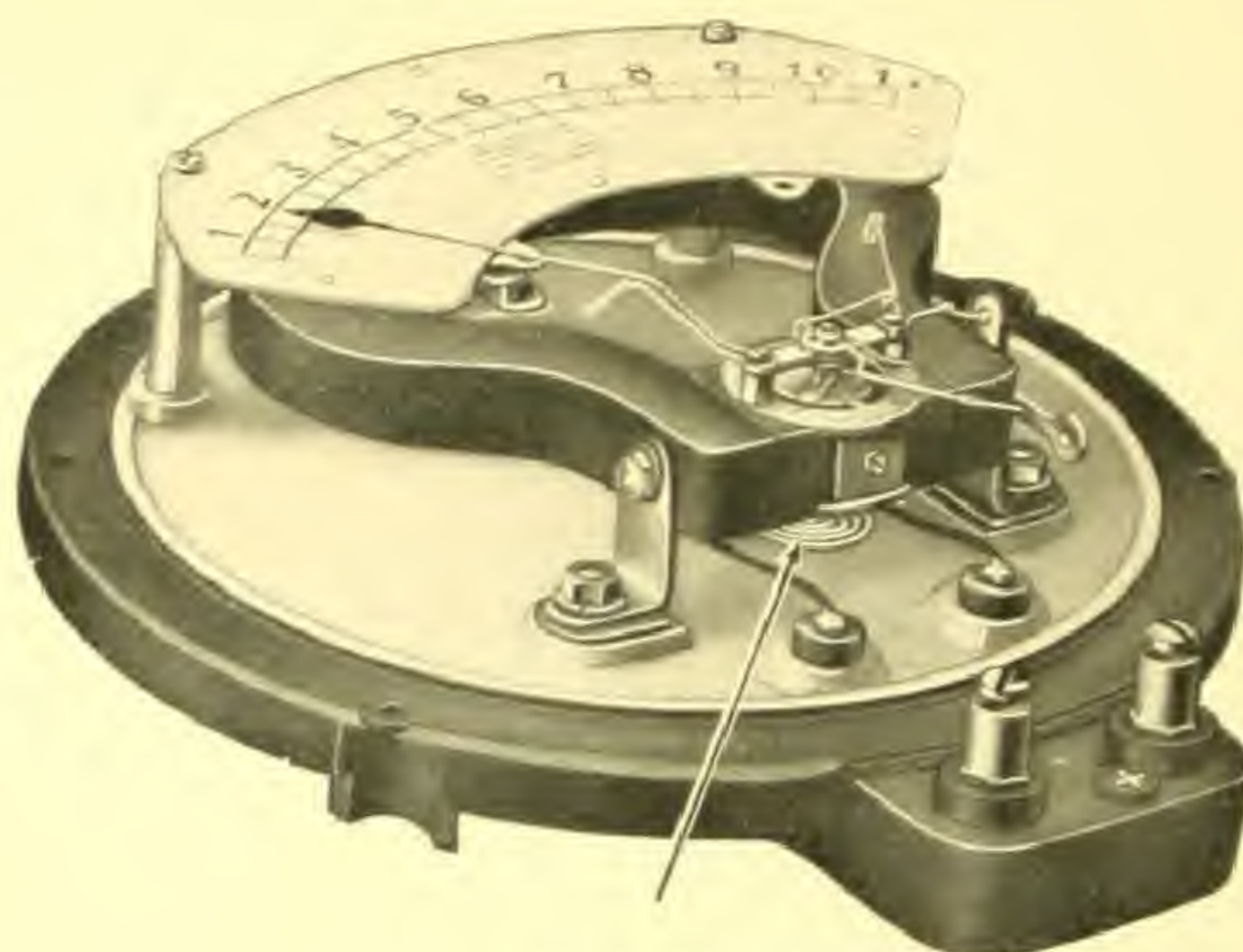


Figure 1790

Arrow points to Automatic Cold-End Compensator

### PRINCIPLE OF OPERATION

The instruments featured in this catalog operate on the Thermo-Electric Principle. For those who are not familiar with this law, it should be explained that by joining two dissimilar metals, or alloys, and applying heat to the point of junction, an electro-motive force is generated. The electro-motive force increases in proportion to the heat. In using this principle in pyrometry, an electrical instrument called a Milli-voltmeter is placed in the circuit to measure the electro-motive force generated. The scale on the milli-voltmeter is marked off in degrees of temperature, thus providing a direct temperature reading instrument.

### HISTORICAL DATA

The thermo-electric principle of temperature measurement was first discovered, a little over a hundred years ago, by Seebeck. Since that time, many scientists have experimented along these lines, and instruments have been made incorporating the basic principle. These earlier instruments used a High Resistance Galvanometer of the suspension type, and thermo-couples of Platinum and Rhodium. This made a very expensive apparatus and too delicate for use except in experimental laboratories, and even there, great care was required in handling. About 1905, Professor William H. Bristol perfected a thermo-electric pyrometer sufficiently rugged to be used in connection with industrial processes. This was the first Thermo-Electric Pyrometer ever developed suitable for everyday use under ordinary shop conditions.



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## HIGH RESISTANCE PYROMETER

Interior View

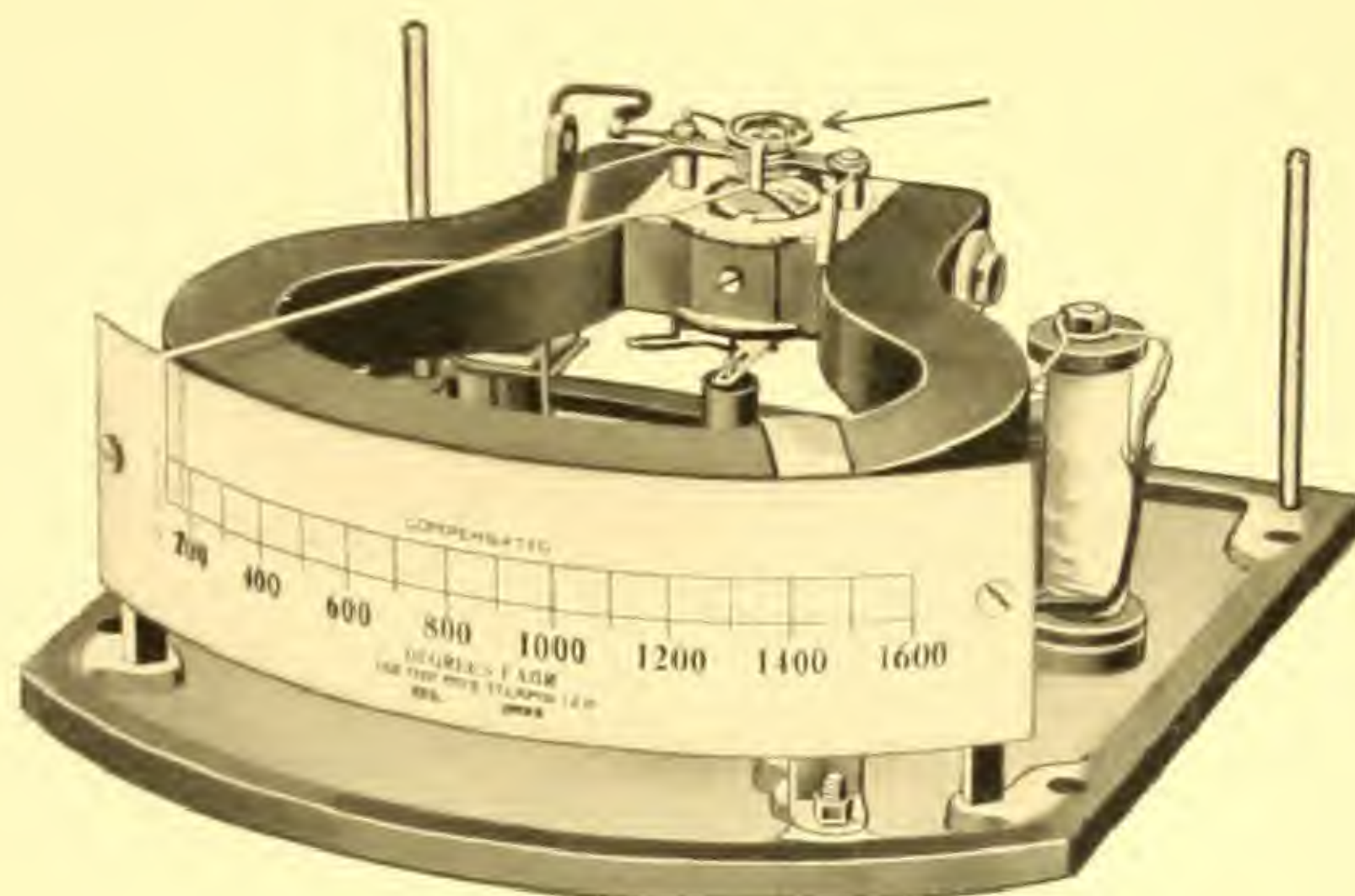


Figure 1791

Arrow points to Automatic Cold-End Compensator

### LOW RESISTANCE PYROMETERS

The first Bristol's Pyrometers utilized Low Resistance Movement with moving coil mounted in double pivot jewel-bearing. With this were used thermo-couples of inexpensive base metals. This provided an equipment capable of good results without the liability of injury due to rough handling or vibration of the building, and at a reasonable cost. The need of such an equipment was recognized in plants using high temperatures for heat-treating. Thousands of these pyrometers were placed in use, and many of the original instruments are still in service.

### HIGH RESISTANCE PYROMETERS

The use of Pyrometers in the industries increased and with it a bigger field of application. To meet the demand, developments were made in Bristol's Pyrometers, which resulted in a line of High Resistance Instruments. The possibility with these is less restricted than with the lower resistance. They are more sensitive to changes in temperature—it is possible to use long lengths of leads or extension—and the additional resistance in the instrument makes any small change in outside resistance negligible. The double pivot jewel-bearing mounted coil, however, is retained, and thus the essential ruggedness of the Low Resistance Instrument has not been sacrificed, to the high resistance movement. The improved Moving Coil and Pointer used in Bristol's High Resistance Pyrometer is shown in Figure 1720 on page 4.



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## MOVING COIL AND POINTER USED IN HIGH RESISTANCE INDICATING PYROMETER

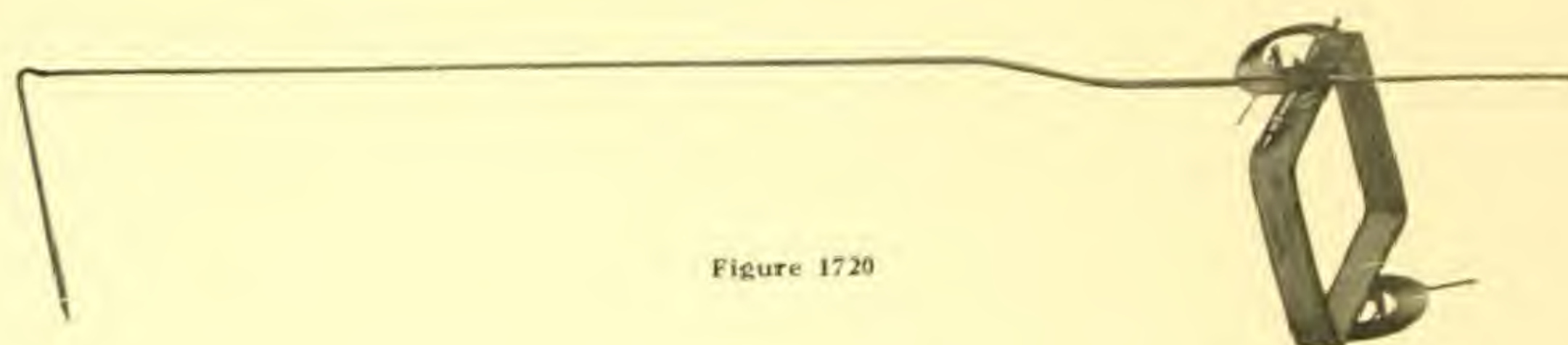


Figure 1720

### THERMO-COUPLES

The two metals of the thermo-couples are supplied in the form of two wires welded at one end, and the term Fire-End is commonly applied to this part of the equipment. The welded junction is always referred to as the Hot-End, and is the part placed in the furnace or other equipment, of which the temperature is to be measured. The opposite end is known as the Cold-End. In using the pyrometer it is, of course, the temperature surrounding the hot-end of the thermo-couple which it is desired to measure. The difference between the temperature of the hot-end and the cold-end of the thermo-couple, determines the true temperature at the hot-end. The principle of thermo-electric pyrometry makes the cold-end temperature an important feature, materially affecting the accuracy of the equipment. It cannot be lost sight of, but must be taken into consideration and accounted for. To obtain a true reading of the hot-end temperature, the opposite or cold-end, must be maintained at a constant degree—corrections made for any changes of temperature at the cold-end—or to compensate for such changes. The Bristol Company has spent many years in experimental work to determine the most efficient means of taking care of cold-end temperature changes. It is their policy to make all apparatus entirely automatic, and as simple as possible, therefore, Automatic Compensation has no rival in the choice.

### COLD-END COMPENSATION

Many methods of taking care of cold-end variations have been tried out, but the Automatic Internal Cold-End Compensator used with Bristol's Pyrometers is without a doubt the most satisfactory of anything yet offered. A greater simplicity in the complete outfit is possible with the use of this Automatic Compensator. It eliminates all superfluous apparatus and simplifies the pyrometer equipment to just three units; the Fire-End—Flexible Couple Extension—and the Pyrometer instrument. The readings on the instrument are absolute. There is no cold-end error to be accounted for. It eliminates any necessity of maintaining a constant cold-end temperature or the special wiring and apparatus required to accomplish it. All models of Bristol's Pyrometers can be furnished with the Automatic Compensator. It is standard equipment and always furnished unless otherwise specified, except for double scale instrument, for which only one scale range can be compensated. Any instrument now in service can also be made up-to-date and equipped with this Compensator.



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## AUTOMATIC INTERNAL COLD-END COMPENSATOR

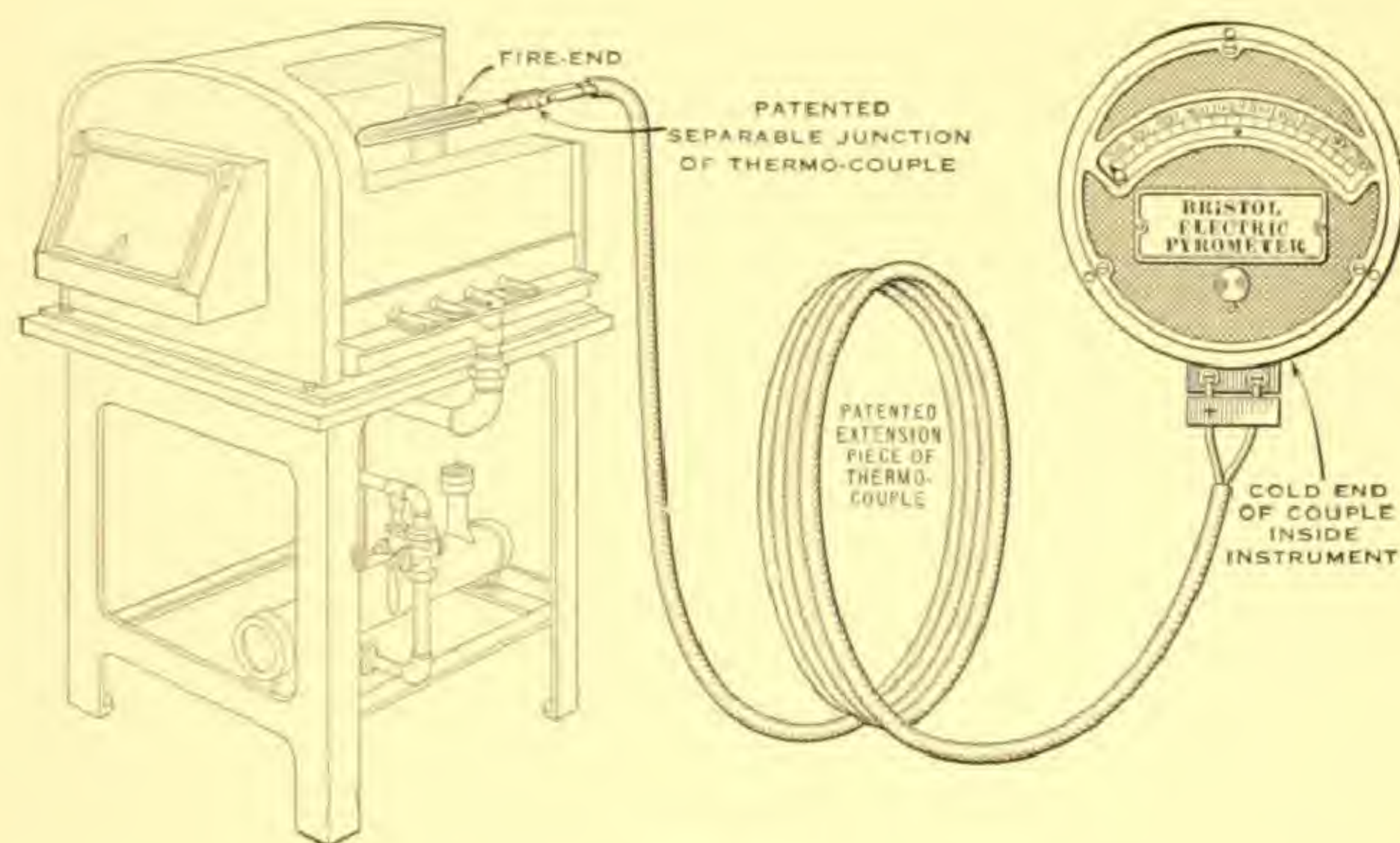


Figure 1378

### AUTOMATIC INTERNAL COLD-END COMPENSATOR

The compensating device is very simple; consisting of a thermostatic metal of spiral shape and is mounted inside the instrument (see illustration Figures Nos. 1790 and 1791). In using this compensator, leads from the fire-end to the instrument are made of the same material as the fire-end, and called Flexible Couple Extension. Thus, the cold-end of the fire-end is located inside the instrument (see diagrammatic sketch Figure 1378).

It is a known fact that the pyrometer will read correctly if the zero of the instrument pointer is set to indicate the temperature of the cold-end. Now as the instrument has become the cold-end, it is simply necessary to set the zero to the temperature of the instrument and the reading will be correct. This is just what Bristol's Automatic Internal Cold-End Compensator does; not occasionally or once each hour, but continuously day and night. The resulting readings on the pyrometer instrument are absolute, no allowance for corrections are necessary. There is no further expense other than the original cost, nothing in this compensator to get out of order, it is absolutely fool-proof.

This Automatic Internal Cold-End Compensator is an original feature with Bristol's Pyrometers.

ELECTRICITY

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## INDICATING PYROMETER HIGH RESISTANCE MODEL 420

For Wall or Switchboard Use

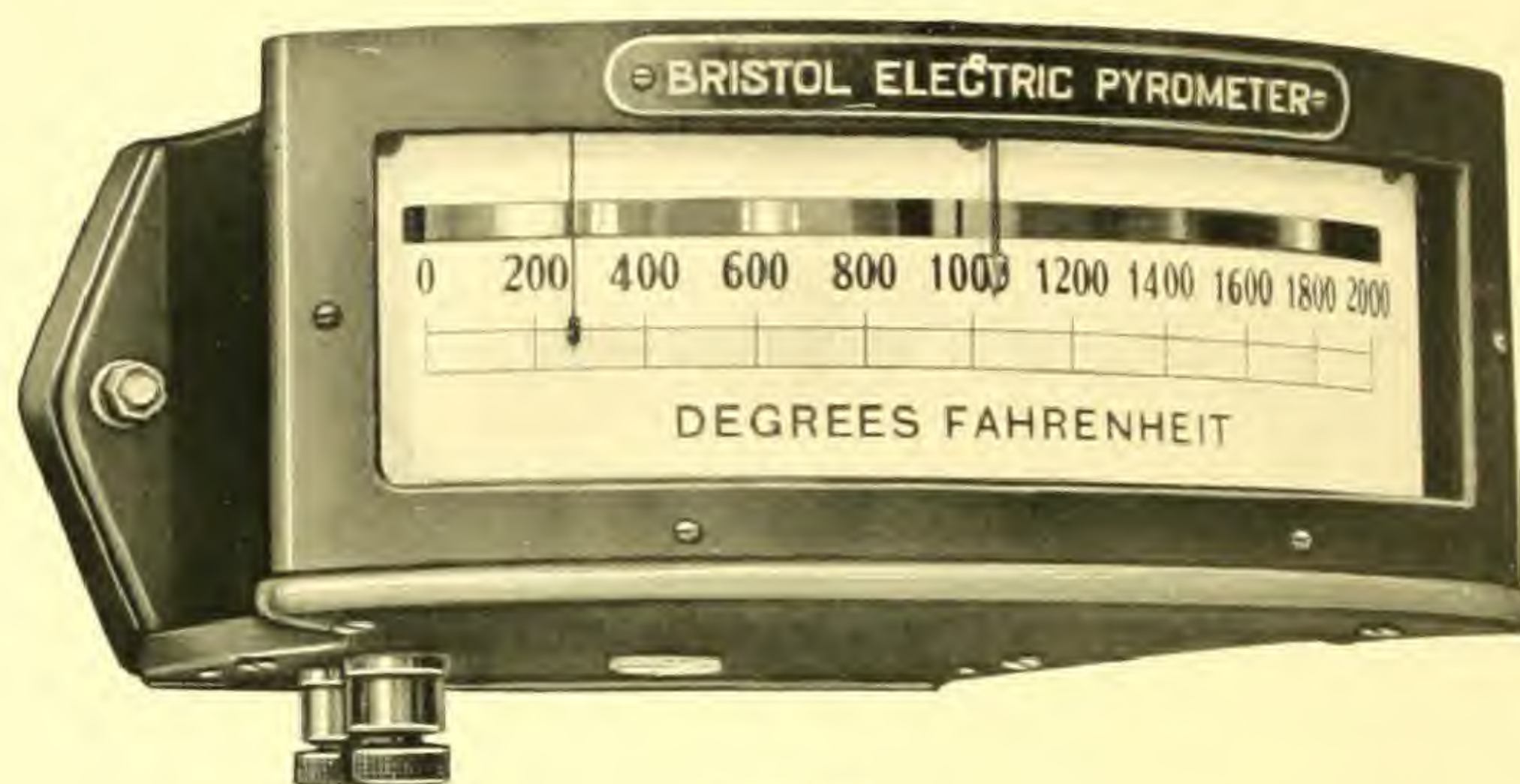


Figure 2273

A pyrometer which is easy to read even at a distance, because of the wide open scale. In actual measurement the scale is 7-inches. As a further aid to easy visibility a combination pointer is provided, having a broad section for distance reading and a knife blade section for accurate close-up work. In addition to these features the scale is also provided with a mirror, which eliminates any possible errors in reading due to parallax.

A High Resistance "Weston" Millivoltmeter is used for the measuring element. This movement is equipped with an accurately balanced moving coil and pointer. It is extremely sensitive, having a resistance of 15 to 20 ohms per millivolt. The movement is also well damped, making it dead beat in operation.

The correctness of design and construction of this instrument gives it the qualities required for long continued service, and with little attention. Furthermore, the original calibration is not easily impaired. These characteristics make it a desirable equipment for every-day-shop-use.

The usual cold-end error inherent in thermo-electric pyrometry is absolutely and automatically eliminated, by Bristol's Automatic Internal Cold End Compensator. Because of it, the readings on the scale are accurate and no allowance for correction is necessary. This is a part of the standard equipment and is always furnished unless otherwise specified.

The case is made of cast aluminum and is of dust-proof construction. It is arranged for wall or switchboard mounting, having a demountable base for separately bolting to the wall and supporting the instrument. When the instrument is to be located in excessively dirty places or where it will be subjected to dampness or chemical fumes, an extra wooden protection case, which can also be furnished, is recommended to be used for such places.



This pyrometer equipment can be furnished for all ranges up to 3000° F. Scales within these limits can be supplied for individual needs.

A small adjusting screw on the outside of case provides an easy means of zero adjustment. And a knob on the top of the case makes it possible to set the normal index spotter to temperature desired for each individual piece of work.

There is an unavoidable variation of temperature in the pyrometer instrument itself which influences the correctness of the reading. This factor has been taken into consideration, and the Model 420 is so designed that any effect of temperature changes on the accuracy of the instrument is minimized.

Summarizing all the features of the Model 420 Pyrometer, the result is a positively actuated pointer. In details, this means there is ample power to overcome any friction with the consequent lag and uncertainty of motion. It is an instrument which can be depended upon to respond immediately to even slight changes in temperature.

200 400 600 800 1000 1200 1400 1600 1800 2000

DEGREES FAHRENHEIT

INTERNAL RES. OHMS

USE FIRE ENDS STAMPED 18B  
MODEL 420

COLD END COMPENSATED  
No.

EXT. RES. OHMS  
SCALE No. 908

Sample Scale as used with Pyrometer Model 420

### LIST OF SCALES

AVAILABLE FOR USE WITH PYROMETER MODEL 420

No.	TOTAL RANGE	MAIN DIVISIONS	SUB DIVISIONS	FIRE END MATERIAL
913	50-800° F.	50	10	18B
914	50-1100° F.	50	10	18B
907	0-1600° F.	100	20	18B
908	0-2000° F.	100	20	18B
909	0-2100° F.	100	20	25H
910	0-2500° F.	100	20	25H
911	0-3000° F.	100	20	27
912	0-1100° C.	50	10	18B

### LIST PRICES

Pyrometer Instrument Model 420, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard scale range selected from list	\$88.00
When calibrated to special scale range to order, add (to list price for instrument)	5.00
Equipped with double range scale, and compensated for one range only, add (to list price for instrument)	25.00

ELECTRICITY

MOTION, ETC.



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## INDICATING PYROMETER HIGH RESISTANCE MODEL 322

For Portable Use



Figure 2506

The Portable Indicating Pyrometer shown is intended for use where a sensitive high-grade instrument is required to be used in many different places in the plant, but where the permanent installation of a pyrometer is not warranted. It is an admirable instrument for making experimental tests, checking other pyrometer equipment, and for such applications as taking temperatures in Fire Box, Molten Metal, etc.

The interior construction of the milli-voltmeter movement in this High Resistance Portable Indicating Pyrometer, is similar to that in Switchboard Model 420, described on page 6. Bristol's Patented Automatic Internal Cold-End Compensator is standard equipment in Model 322, and always furnished unless otherwise specified.

The internal resistance of Portable Model 322 is over 300-ohms when used in connection with base metal thermo-couples for temperatures up to 2500°F, and over 100-ohms when used in connection with Platinum Platinum-Rhodium thermo-couples for temperature up to 3000°F.

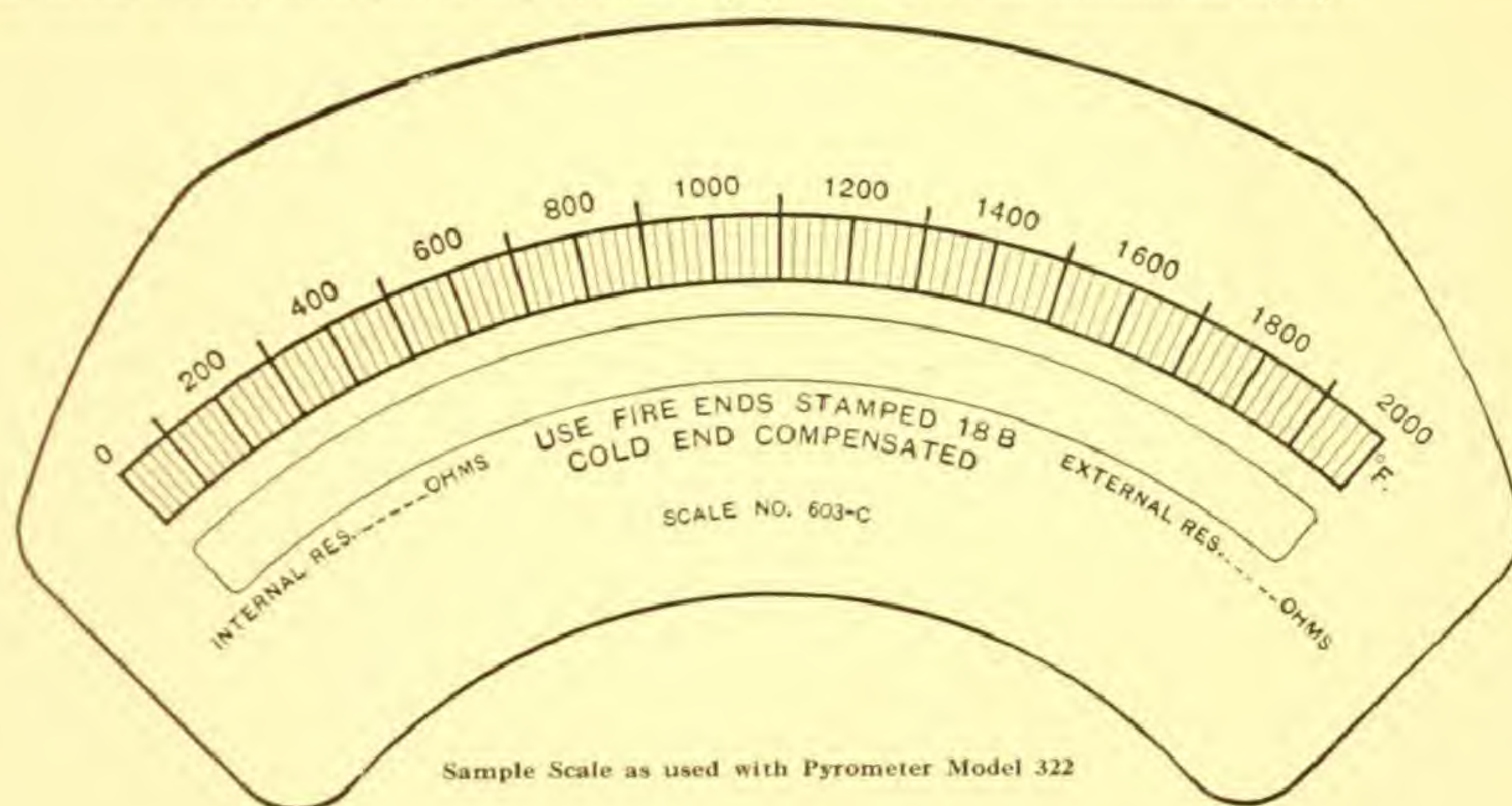
To avoid error due to parallax when taking readings, a mirror scale and knife-blade pointer are used. Scales can be furnished to read in degrees Fahrenheit or Centigrade, also double



scales, one in Fahrenheit, the other Centigrade or Millivolts. With the double scale an extra binding post is provided. See lists of scales below. When double scale and Automatic Compensator are used, only one scale can be compensated. External zero adjustment is taken care of by a small adjusting screw on the front of the movement.

A rheostat is furnished with Model 322 which is operated by knob on right-hand side of case as shown in illustration. This is especially valuable when instrument is to be used for checking other pyrometer equipment. It provides an easy and quick means of adjusting resistance to agree with that of extension leads and fire-ends. If desired, instrument can be furnished without the rheostat.

The case is of wood, with high polish finish, provided with leather handle for carrying, also lock and key. An electrical damping device automatically operates when the cover is closed, which prevents the pointer from excessive vibration and the moving coil from injury while being carried about. The operating parts including the binding posts are completely enclosed when the cover is shut, thus protecting against any possible external mechanical injury.



Sample Scale as used with Pyrometer Model 322

## SCALES

AVAILABLE FOR USE WITH PYROMETER MODEL 322

No.	TOTAL RANGE	MAIN DIVISIONS	SUB DIVISIONS	FIRE END MATERIAL	No.	TOTAL RANGE	MAIN DIVISIONS	SUB DIVISIONS	FIRE END MATERIAL
600C	0-800°F	50	10	18 B	609C	0-425°C	25	5	18 B
601C	0-1100°F	50	10		610C	0-600°C	50	10	
602C	0-1600°F	100	20		611C	0-850°C	50	10	
603C	0-2000°F	100	20		612C	0-1100°C	50	10	
604C	0-2100°F	100	20	25 H	613C	0-1150°C	50	10	25 H
605C	0-2500°F	100	20		614C	0-1350°C	50	10	
606C	0-2600°F	100	20	26 H	615C	0-1400°C	50	10	26 H
607C	0-3000°F	100	20	27	616C	0-1650°C	100	20	27
*608	18M.V.	1	2	18 B	*617	18M.V.	1	2	18 B
	0-2000°F	100	20	27		0-1100°C	50	10	27
	0-3000°F	100	20			0-1650°C	100	20	

## LIST PRICES

Pyrometer Instrument Model 322, equipped with Automatic Internal Cold-End Compensator, and Calibrated for standard scale range selected from list, complete with External Switch for resistance adjustment.	\$110.00
Same specifications as above, but without External Switch.	88.00
When calibrated to special scale range to order, add (to list price for instrument)	5.00
*Equipped with double range scale, and compensated for one range only, add (to list price for instrument)	25.00

ELECTRICITY

MOTION, ETC.



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## INDICATING PYROMETER LOW RESISTANCE MODEL 410

For Wall or Switchboard Use

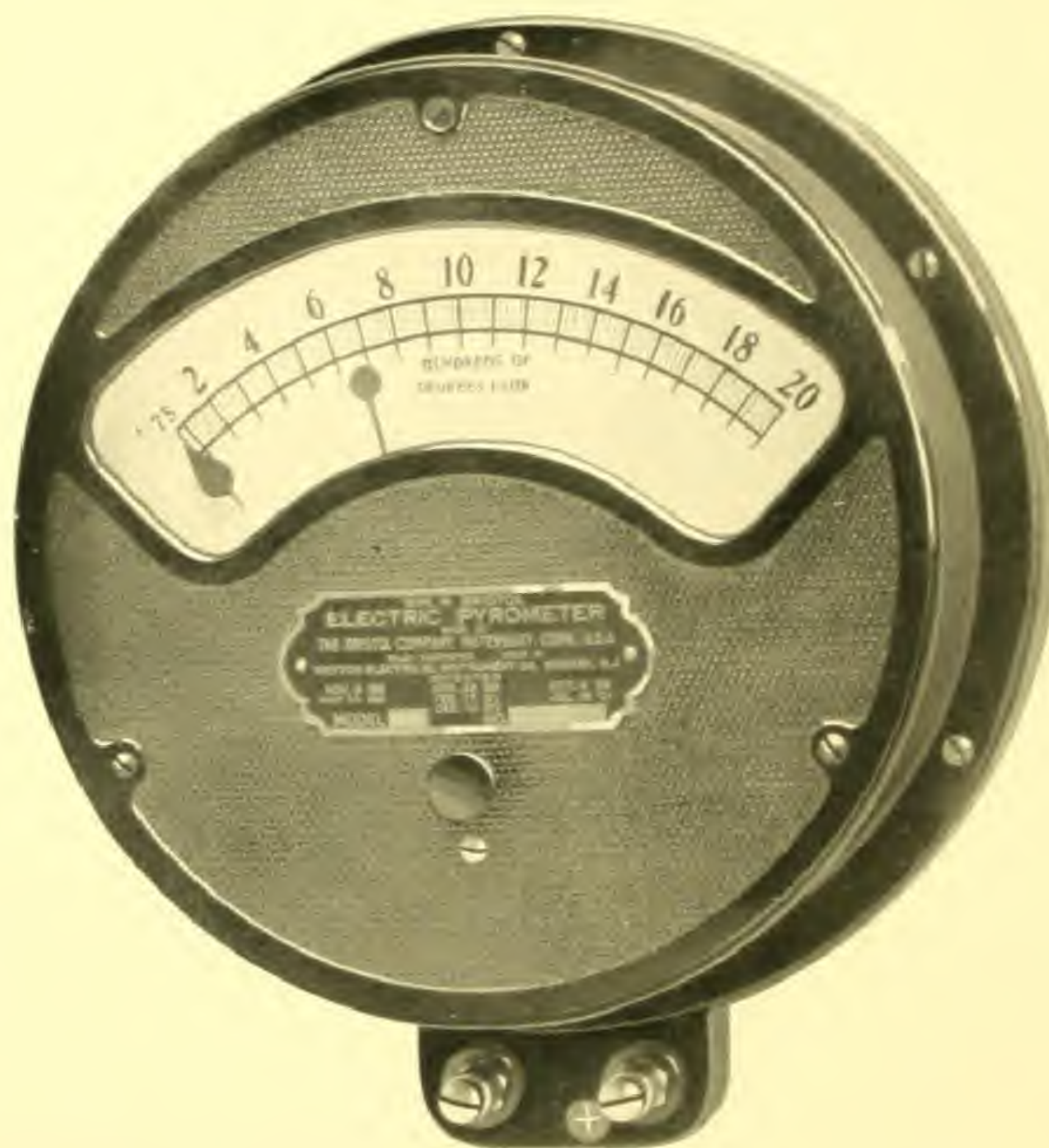


Figure 1282

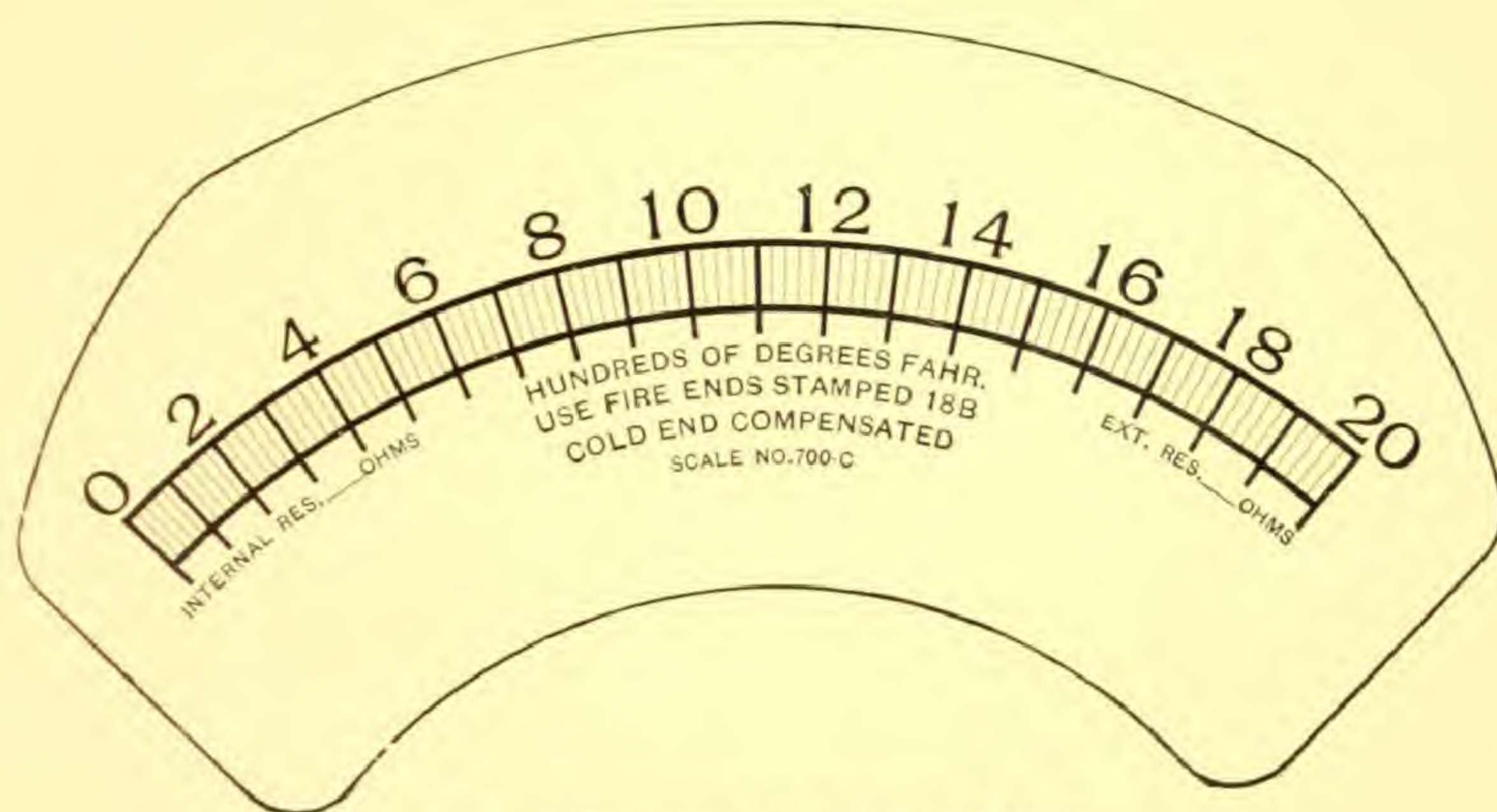
Where the extra sensitive High Resistance Pyrometer is not required, Indicating Pyrometer Model 410 provides a very practical and rugged instrument for general shop use, capable of indicating temperatures up to 2500°F or Centigrade equivalent. Although the internal resistance of Model 410 is lower than that of 420, yet when used with base metal couples for a 2000°F scale, the resistance is approximately 35-ohms. This is sufficient to allow the use of long lengths of standard size leads or extensions.

The measuring element is a "Weston" millivoltmeter movement. Bristol's Automatic Internal Cold-End Compensator is also standard in this instrument and always furnished unless otherwise specified.



This pyrometer instrument is exceptionally rugged, which is well proved by the fact that hundreds of these pyrometers are now used in railway locomotives and steamships, in connection with super-heated steam temperatures, and giving satisfactory service, notwithstanding the excessive vibrations encountered.

The case is all metal with black enamel finish, designed for mounting directly on wall or switchboard. Easy zero adjustment is provided by small screw on the outside of case. Although the case is dust-proof, it is often advisable to use an extra wooden protection similar to that shown on page 37, as an added protection. This especially applies where the instrument is to be located in excessively dusty place, or where subjected to fumes, vapors, sudden drafts of cold or heat.



Sample Scale as used with Pyrometer Model 410

### LIST OF SCALES

AVAILABLE FOR USE WITH PYROMETER MODEL 410

No.	TOTAL RANGE	MAIN DIVISIONS	SUB DIVISIONS	FIRE END MATERIAL	No.	TOTAL RANGE	MAIN DIVISIONS	SUB DIVISIONS	FIRE END MATERIAL
703C	0-1100°F	50	10	18 B	705C	0-2100°F	100	20	25 H
702C	0-1600°F	100	20		706C	0-2500°F	100	20	18 B
701C	0-1800°F	100	20		704C	0-1100°C	50	10	
700C	0-2000°F	100	20						

### LIST PRICES

Pyrometer Instrument Model 410, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard scale range selected from list. \$66.00

When calibrated to special scale range to order, add (to list price for instrument) 5.00



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## RECORDING PYROMETER, HIGH RESISTANCE SMOKED CHART, MODEL 437

FOR WALL OR SWITCHBOARD USE



Figure 1755

The use of a Recording Pyrometer for the operator is even a greater help to him in securing and maintaining correct temperatures than the indicating type of instrument. This is particularly so where the time element is important. The charts are marked off in time arcs, so that it is possible to know just how long it takes to reach a certain degree of temperature and how long it is maintained. The operator may have several furnaces to look after or other duties to perform. With a recorder he can tell at a glance what the temperature conditions are now, what they have been and in what direction they are leading. It is not necessary to stop and take readings as with an indicating instrument. Furthermore, the charts are always available for the supervisor when he comes around, and for filing away to be referred to in the future to duplicate orders, to make up engineering data, to help settle disputes.

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Figure 1822



Figure 1821

Temperatures up to 3000°F or Centigrade equivalent are recorded with Bristol's High Resistance Recording Pyrometer Smoked Chart Model 437. Charts 8-inches in diameter are used, see full size specimen chart on page 18. List of charts with standard ranges for which instruments can be calibrated are given on pages 19 and 20. A "Weston" pivot-jewel bearing millivoltmeter measuring element is used, which is well damped and absolutely dead-beat in operation. The instrument is regularly furnished with Patented Automatic Internal Cold-End Compensator.

The frictionless smoked chart recording system is employed exclusively with this Round Chart Recording Pyrometer. A sensitized smoked surface (carbon coated) chart is used, against which the penarm is periodically pressed once every ten seconds. The penarm then swings clear of the chart and is left free to take a new position, leaving a white dot impression each time. The record produced is, therefore, a series of white dots making a practically continuous line. On removing the chart from the instrument it is dipped in a fixing solution which makes the record permanent. This method is superior to others because there is absolutely no retarding action of the penarm due to friction as encountered in most other recording systems. This is very important owing to the delicate operation of the millivoltmeter movement. This method of recording is also independent of temperature conditions and is equally efficient when subjected to extremely high or low temperatures.

The millivoltmeter element together with the penarm is hinged to back of the case, so that when changing the chart these may be swung clear and, thus, no possible danger caused by handling. This is clearly illustrated in Figures Nos. 1821 and 1822.

A powerful high-grade 24-hour clock is used to revolve the chart and operate the penarm vibrator.

The case is all metal and dust-proof. The standard finish is black enamel with nickel raised parts.

### LIST PRICES

Pyrometer Instrument Model 437, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard chart scale range selected from list. \$132.00

When calibrated to special chart scale range to order, there is an extra charge which will be quoted on request.

ELECTRICITY

MOTION, ETC.



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**RECORDING PYROMETERS, HIGH RESISTANCE  
SMOKED CHART, MOISTURE PROOF  
MODEL 424**

FOR PORTABLE USE



Figure 1718

Description and prices on opposite page.

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## RECORDING PYROMETERS, HIGH RESISTANCE SMOKED CHART, MOISTURE PROOF MODEL 424

### FOR PORTABLE USE

This is the type of case which is recommended for a Portable Recording Pyrometer to be used where it will be subjected to moisture, chemical fumes or very dusty and dirty places.

The working parts of this instrument are exactly the same as those in Model 437, previously described. The case is aluminum, thus, light weight and rugged, and made moisture-proof with gaskets and screw clamps. Leather handle is provided to make it easy to carry about. The finish of the case is black enamel.

This Moisture-Proof Model 424 can be furnished to record temperatures up to 3000°F or Centigrade equivalent. For lists of charts and ranges to which this instrument can be calibrated, see pages 19 to 21.

A similar case to that shown above, but for wall or switchboard mounting is made in cast iron. Instead of the leather carrying handle, lugs are provided on the back for fastening to wall or switchboard. This style is furnished where a special protection and rugged case is required for permanent mounting, and is known as Model 439.

### LIST PRICES

Pyrometer Instrument Model 424, in aluminum case for portable use, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard chart scale range selected from list...	\$147.00
Pyrometer Instrument Model 439, in cast iron case for wall or switchboard mounting, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard chart scale range selected from list...	138.00
When either of the above instruments are to be furnished calibrated to special chart scale range to order, there is an extra charge which will be quoted on request.	

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

# RECORDING PYROMETERS HIGH RESISTANCE SMOKED CHART MODEL 414

FOR PORTABLE USE

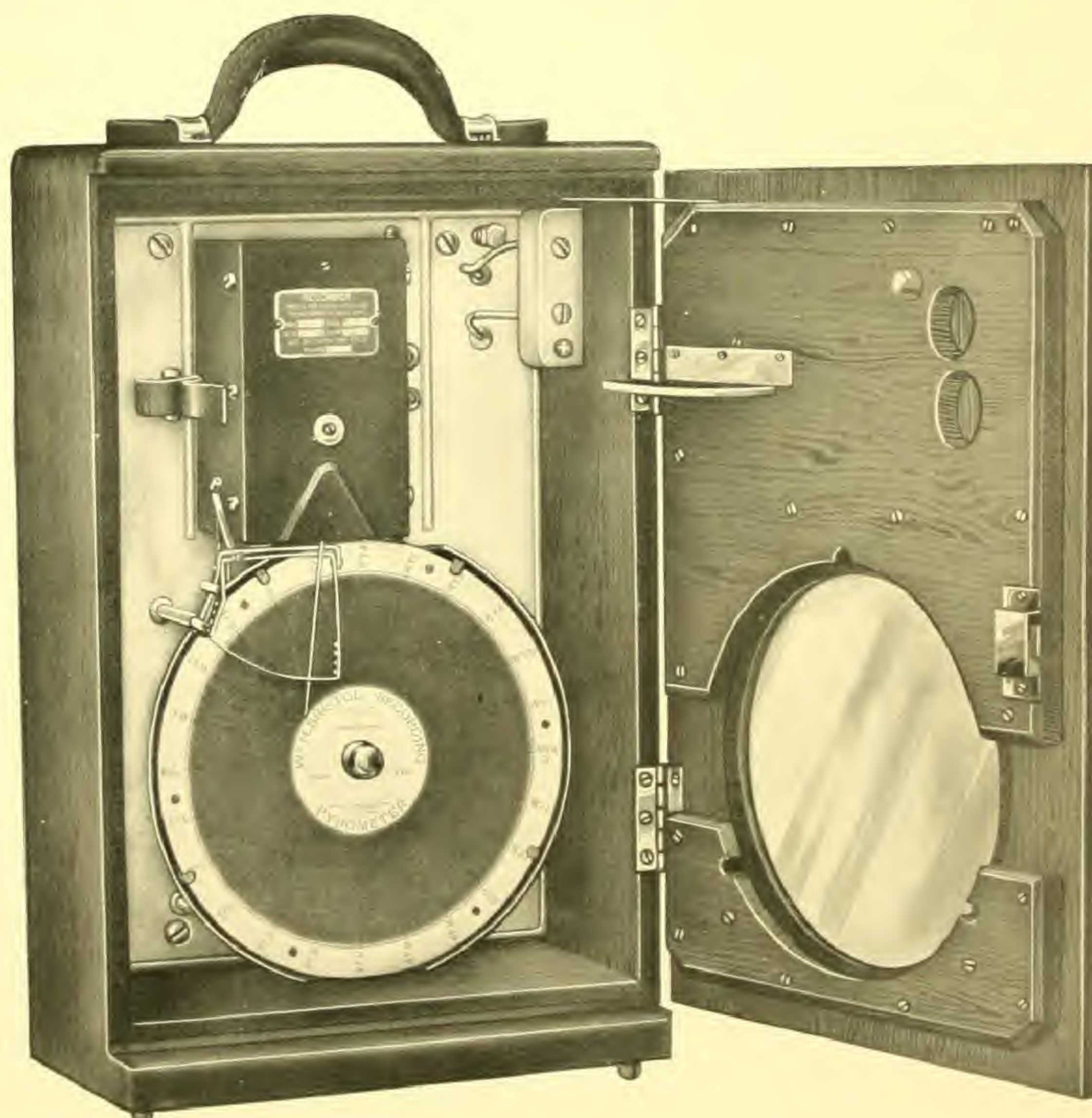


Figure 1717

Description and prices on opposite page.

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## RECORDING PYROMETER HIGH RESISTANCE, SMOKED CHART MODEL 414

### FOR PORTABLE USE

For investigative and experimental purposes—in places where a recording Pyrometer is required in several different locations, but none of which requires a permanent installation, also as auxiliary instrument to permanent installation, are some of the uses to which Portable Recording Pyrometer Model 414 is adapted. The fact that Bristol's Pyrometers are equipped with Automatic Internal Cold-End Compensator and Inter-changeable Leads make these instruments particularly well suited as an auxiliary instrument in case of emergency.

This Portable Recording Pyrometer uses the same interior construction as Model 437, and can be furnished to record temperatures up to 3000°F or Centigrade equivalent. The measuring element is a millivoltmeter of the pivot jewel-bearing type "Weston" make. Bristol's Patented Automatic Internal Cold-End Compensator is standard equipment in this model.

The case is light-finish wood, with leather carrying handle. The equipment is compact and provides a pyrometer unit, capable of high-grade results. It is a very rugged instrument and will stand even considerable abuse without impairing the efficiency.

See pages 19 to 21 for list of charts and ranges to which this instrument can be calibrated.

### LIST PRICES

Pyrometer Instrument Model 414, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard chart scale range selected from list \$132.00

When calibrated to special chart scale range to order, there is an extra charge which will be quoted on request.

TEMPERATURE

RESISTANCE, SMOKED CHART MODEL 414

ELECTRICITY

MOTION, ETC.



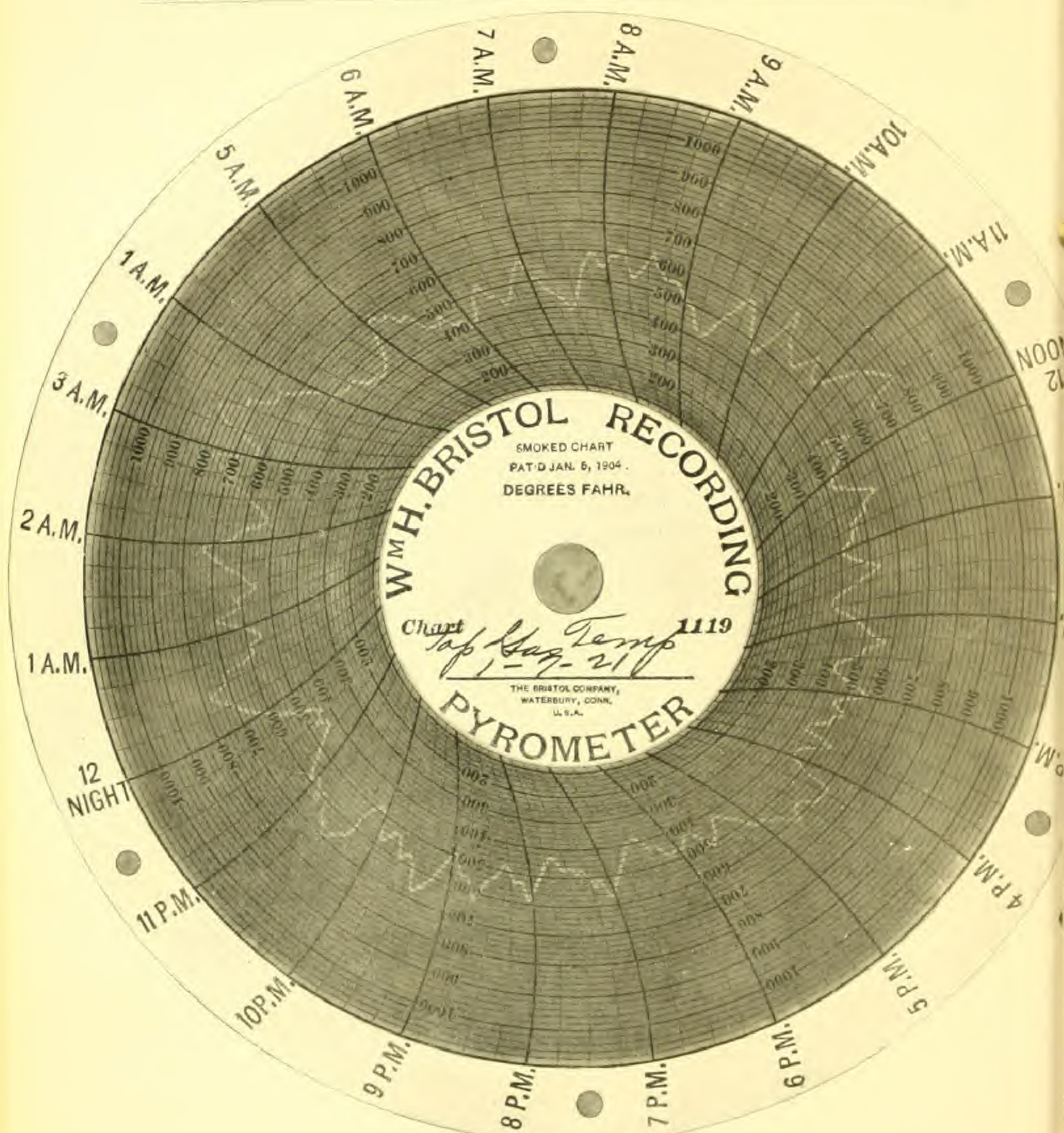


Figure 1792

Full size specimen record made with Bristol's Recording Pyrometer Model 437, of Blast Furnace Top Gas Temperatures. This illustrates the use of Patented Frictionless Smoked Chart Recording System, which is the method used on all Bristol's Round Chart Recording Pyrometers.

NOTE—Chart additional to the main body of the book.



## COMPLETE LIST OF ROUND CHARTS FOR RECORDING PYROMETERS

MODELS Nos. 437, 439, 414 and 424

SEE PAGES 20 AND 21 FOR SPECIMEN SECTIONS OF CHARTS

(CHARTS WITH FULL RANGE SCALE)

Chart No.	Range in Degrees FAHRENHEIT	One Revolution of Chart	Fire-End Material	Chart No.	Range in Degrees FAHRENHEIT	One Revolution of Chart	Fire-End Material
1161	0- 400	24-hour	18B	1152	75-2400	24-hour	25H
†1124	75- 800	7-day	18B	1160	0-2500	12-hour	25H
1103	75- 800	24-hour	18B	2407	32-3000	24-hour	27
1149	75- 900	24-hour	18B	2411	32-3000	12-hour	27
2406	32-1000	24-hour	27		CENTIGRADE		
†1108	75-1100	7-day	18B	1158	0-200	24-hour	18B
1119	75-1100	24-hour	18B	1126	24- 400	24-hour	18B
1142	75-1200	24-hour	18B	1151	24- 450	24-hour	18B
1120	75-1600	24-hour	18B	1145	24- 650	24-hour	18B
1144	75-1600	12-hour	18B	1148	24- 850	24-hour	18B
1153	75-1600	24-hour	25H	1115	24- 900	24-hour	18B
†1147	75-1800	7-day	18B	1123	24-1100	24-hour	18B
1114	75-1800	24-hour	18B	1157	24-1100	24-hour	18B
1118	75-2000	24-hour	18B	1122	24-1100	12-hour	18B
1134	75-2000	12-hour	18B	1125	24-1100	1-hour	18B
1138	75-2000	1-hour	18B	†1117	0-1160	7-day	18B
1150	75-2000	24-hour	25H	1146	24-1375	24-hour	25H
†2410	75-2050	7-day	27	†2408	0-1650	7-day	27
2402	0-2050	24-hour	27	2409	0-1650	24-hour	27
2401	0-2050	1-hour	27				

\*(CHARTS WITH PARTIAL RANGE SCALE)

Chart No.	Range in Degrees FAHRENHEIT	One Revolution of Chart	Fire-End Material	Chart No.	Range in Degrees CENTIGRADE	One Revolution of Chart	Fire-End Material
† 1166	700-1000	7-Day	18B	1139	250- 500	24-hour	18B
1141	700-1000	24-hour	18B	1155	150- 590	24-hour	18B
1129	300-1100	24-hour	18B	1128	250- 650	24-hour	18B
1121	800-1800	24-hour	18B	1156	200- 800	24-hour	18B
1131	800-1800	12-hour	18B	1137	400-1000	24-hour	18B
1159	800-1800	8-hour	18B	1130	500-1000	24-hour	18B
1107	1200-1800	24-hour	18B	1154	300-1100	24-hour	18B
1135	1300-1900	24-hour	18B				

\*NOTE:—Charts with partial range afford extra wide open scale. For all instruments calibrated to use partial range charts, there is an additional charge of \$5.00 each list, except for Charts Nos. 1130—1107—1135—1139—1141 and 1166, which are \$10.00 extra list.

†Instruments equipped with charts for 7-day revolutions add \$35.00 to list price.

ELECTRICITY

MOTION, ETC.

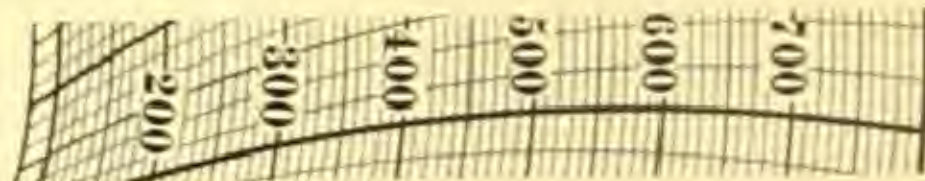

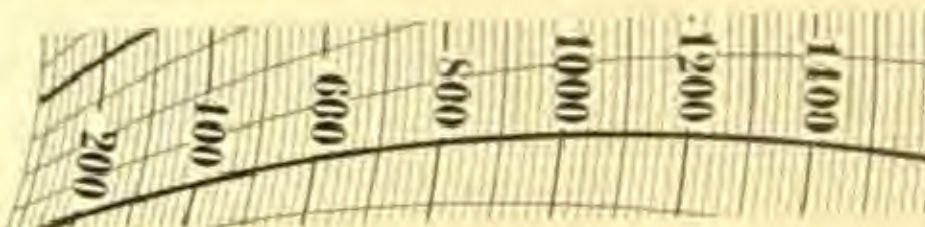
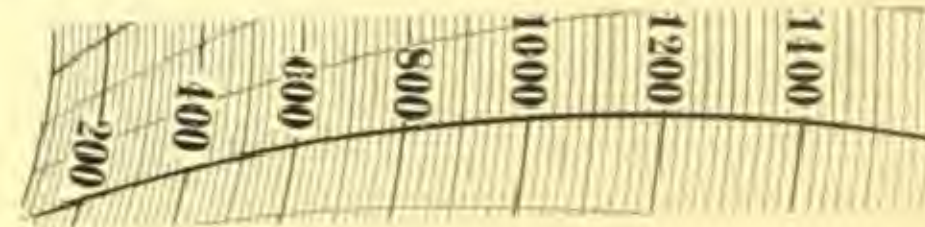
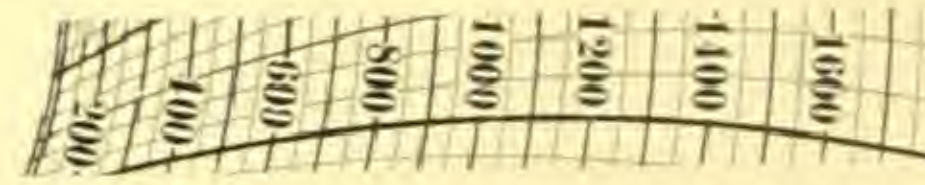
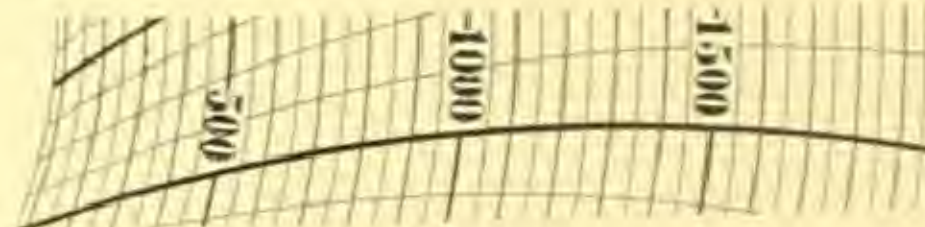
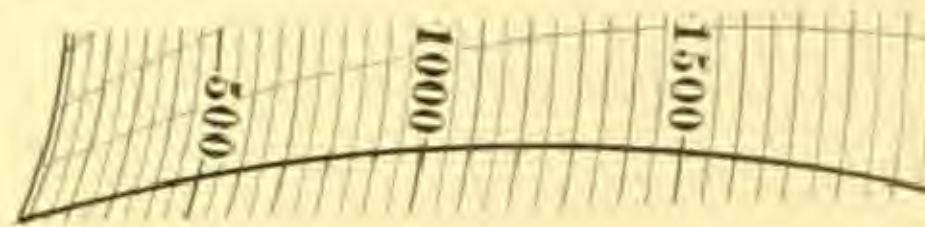


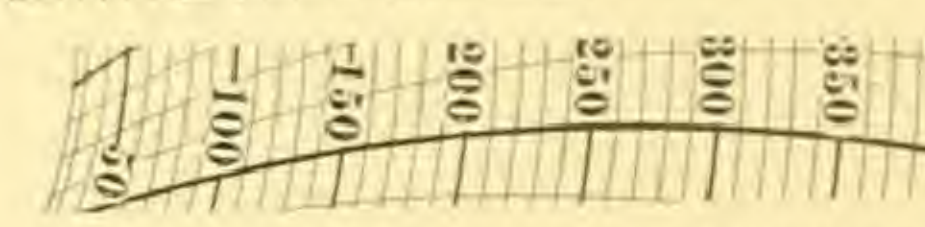
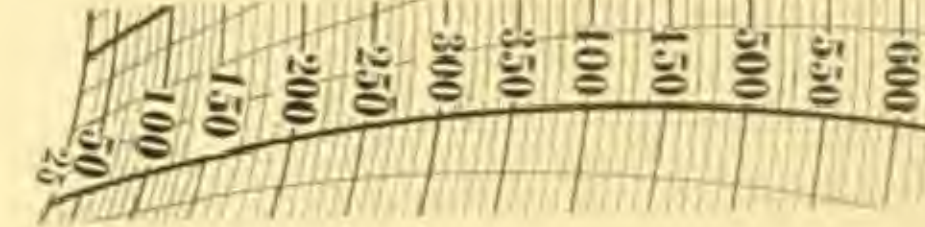


## ROUND CHARTS FOR RECORDING PYROMETERS

### MODELS Nos. 437, 439, 414 and 424

Charts listed here with specimen sections have been selected, because the most often used, from the complete list of charts on page 19.

(CHARTS WITH FULL RANGE SCALE)

Chart No.	Range in Degrees FAHRENHEIT	One Revolution of Chart	Fire-End Material	Specimen Section of Charts
†1124 1103	75- 800 75- 800	7-day 24-hour	18B 18B	
†1108 1119	75-1100 75-1100	7-day 24-hour	18B 18B	
1120 1144	75-1600 75-1600	24-hour 12-hour	18B 18B	
1153	75-1600	24-hour	25H	
†1147 1114	75-1800 75-1800	7-day 24-hour	18B 18B	
1118 1134 1138	75-2000 75-2000 75-2000	24-hour 12-hour 1-hour	18B 18B 18B	
1150	75-2000	24-hour	25H	
1152	75-2400	24-hour	25H	
2407 2411	32-3000 32-3000	24-hour 12-hour	27 27	
1126	CENTIGRADE 24- 400	24-hour	18B	
1145	24- 650	24-hour	18B	

\*Note:—Chart charts, the documents e

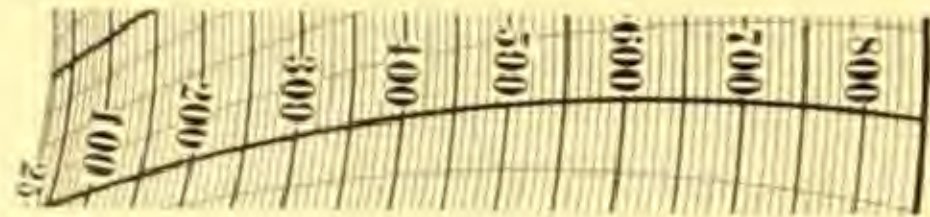
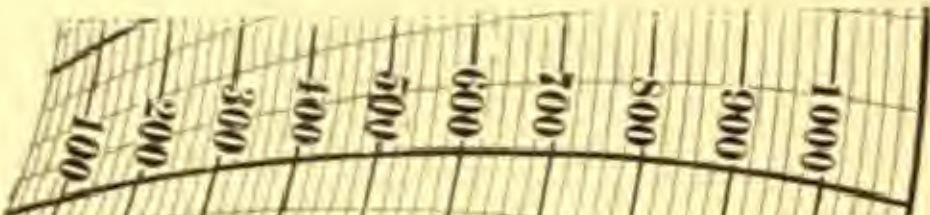

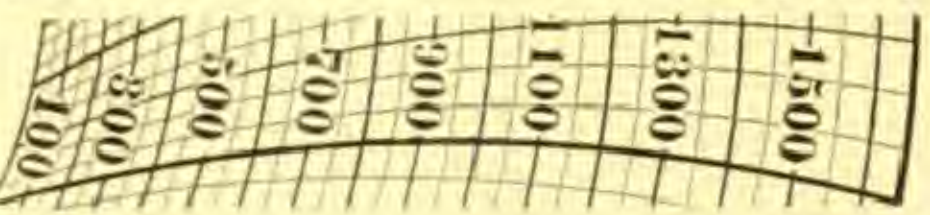


# ROUND CHARTS FOR RECORDING PYROMETERS


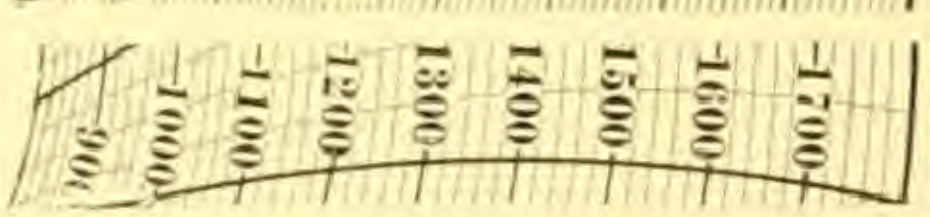



MODELS Nos. 437, 439, 414 and 424

Charts listed here with specimen sections have been selected, because the most often used, from the complete list of charts given on page 19.

(CHARTS WITH FULL RANGE SCALE)

Chart No.	Range in Degrees CENTIGRADE	One Revolution of Chart	Fire-End Material	Specimen Section of Charts
1148	24- 850	24-hour	18B	
1157	24-1100	24-hour	18B	
1146	24-1375	24-hour	25H	
†2408 2409	0-1650 0-1650	7-day 24-hour	27 27	

\*(CHARTS WITH PARTIAL RANGE SCALE)

1129	FAHRENHEIT 300-1100	24-hour	18B	
1121	800-1800	24-hour	18B	
1131	800-1800	12-hour	18B	
1159	800-1800	8-hour	18B	
1107	1200-1800	24-hour	25H	
1128	CENTIGRADE 250- 650	24-hour	18B	
1154	300-1100	24-hour	18B	

\*NOTE:—Charts with partial range afford extra wide open scale. For all instruments calibrated to use partial range charts, there is an additional charge of \$5.00 each list, except for chart No. 1107 which is \$10.00 extra list.

†Instruments equipped with charts for 7-day revolutions add \$35.00 to List Price.

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
 REG. U.S. PAT. OFFICE

## INDICATING PYROMETER WITH MULTIPLE SWITCHBOARD ROTARY SWITCH TYPE

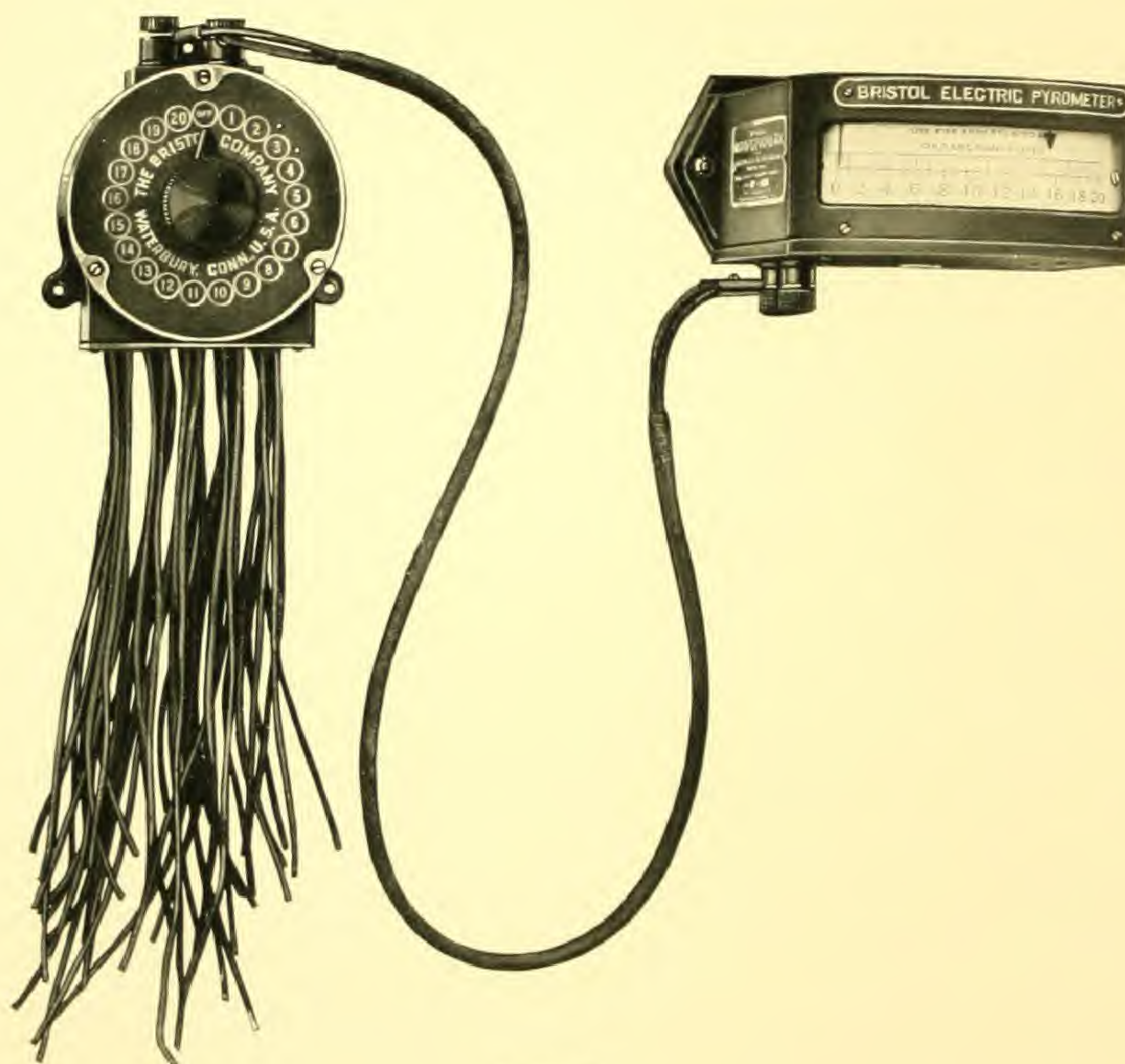


Figure 1719

This shows Indicating Pyrometer used with 20-point Rotary Switch. The leads from the switch represent the twenty fire-end connections which it is possible to have. The switch can be used in a similar manner with a Recording Instrument.

LIST PRICE—Pyrometer Instrument see page 7—Rotary Switch see page 39.

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TRADE MARK  
**BRISTOL'S**  
 REG. U. S. PAT. OFFICE

## COMBINATION UNIT OF INDICATING AND RECORDING PYROMETERS

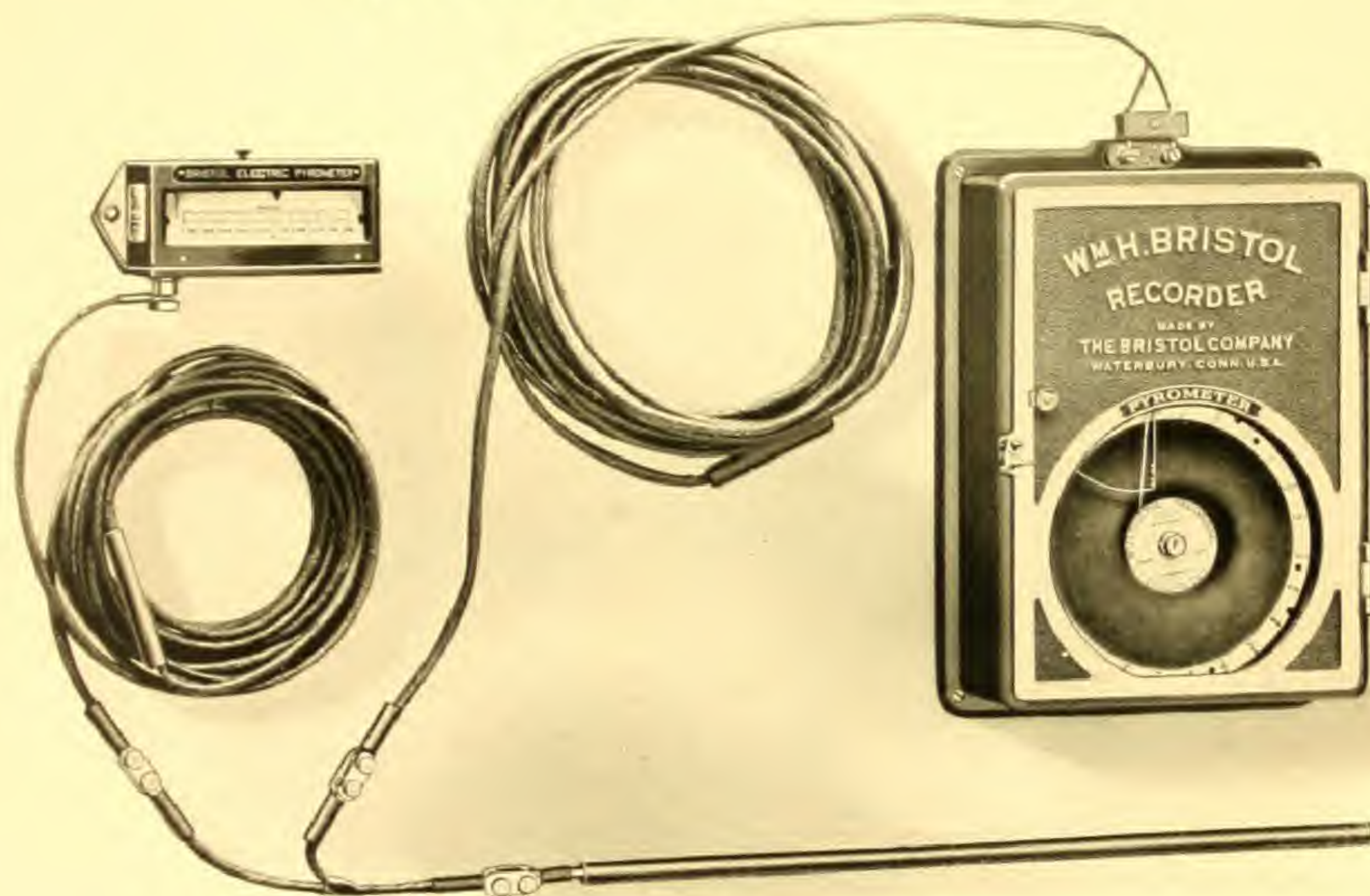


Figure 1435

A method for indicating and recording at the same time the temperature from one fire-end. The Indicating Pyrometer near the furnace to guide the operator, and Recording Pyrometer for the supervisor's office, which gives a continuous check on the operator and a permanent record for filing. Each instrument is complete with Patented Automatic Internal Cold-End Compensator, and both instruments are connected direct to the same fire-end.

The units of this combination are interchangeable, also absolutely independent of each other. They can be used separately by simply detaching the extension from the fire-end.

The above is the most simple form of combination possible. It may be used as a nucleus to be added to from time to time as the department grows. For other combinations of pyrometer instruments see diagrams on page 60.

### LIST PRICES

Pyrometer Instrument, Model 420 equipped with Automatic Internal Cold-End Compensator, and calibrated for Standard Scale Range selected from list	\$ 88.00
When calibrated to a Special Scale Range to order, add (to list price of Instrument)	5.00
Pyrometer Instrument, Model 437 equipped with Automatic Internal Cold-End Compensator, and calibrated for Standard Scale Range using chart selected from list	132.00
Same specifications as above except for Moisture-Proof Case Model 439	138.00
Instruments as above except equipped with Partial Scale less than 50%, add (to price of Instrument)	5.00
Instruments as above except equipped with Partial Scale for 50% and over, add (to price of Instrument)	10.00

When calibrated to special chart scale range to order, there is an extra charge which will be quoted on request.

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

## RECORDING PYROMETER, STRIP CHART SINGLE RECORD, MODEL 425

For Wall or Switchboard Use

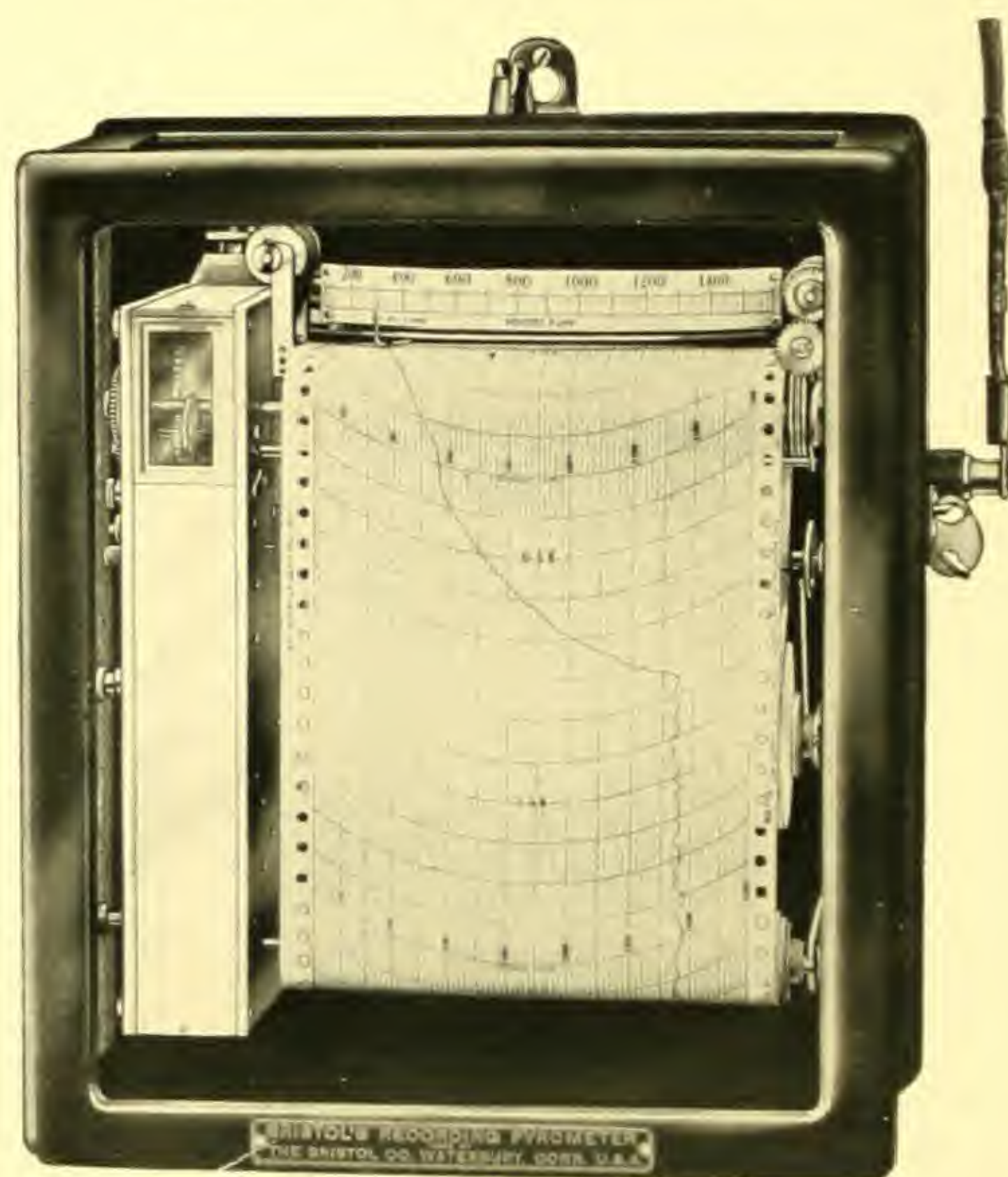


Figure 1492

There are some applications for Pyrometers which require a continuous record of several days duration, and where the daily round chart is not sufficient. In making tests it is also often desirable to have an extra wide open record, so that very close readings may be obtained. For such applications Bristol's Recording Pyrometer with Strip Chart is especially adapted.

The Pyrometer Model 425 uses a chart of semi-transparent onion-skin paper. These charts are 6-inches wide, with actual scale of  $5\frac{1}{4}$ -inches, and furnished in rolls 90-feet long. When driven at the standard speed of 1-inch per hour, the 90-foot chart operates continuously for 45-days. Easy adjustment is provided for other speeds, so that the chart may be driven at the rate of 1-inch, 3-inches and 6-inches per hour, also 1-inch, 3-inches and 6-inches per minute.

The record is a continuous series of dots made by the penarm which is periodically pressed against a colored ribbon, similar to typewriter ribbon. This penarm comes in momentary contact with the paper once every minute, so that when the chart is driven at the standard speed of 1-inch per hour it gives 60 dots an inch, which is practically a continuous line. This method of recording does away with any possible friction or drag between the paper and penarm.



The Pyrometer Model 425 is furnished only in the High Resistance Type. A "Weston" millivoltmeter is used for the measuring element. The instrument is extremely sensitive to changes in temperature, yet so well damped that it is dead-beat in operation. The movement is of the pivot-jewel bearing type, and of sufficiently rugged construction to stand up under the strenuous requirements of every-day industrial use.

Bristol's Patented Automatic Internal Cold-End Compensator is standard equipment with the strip chart model pyrometer. This eliminates all cold-end errors and the consequent complications otherwise encountered.

A specially constructed powerful clock is used to automatically wind the chart roll—drive the record—and operate the penarm. The clock requires winding once every 8-days.

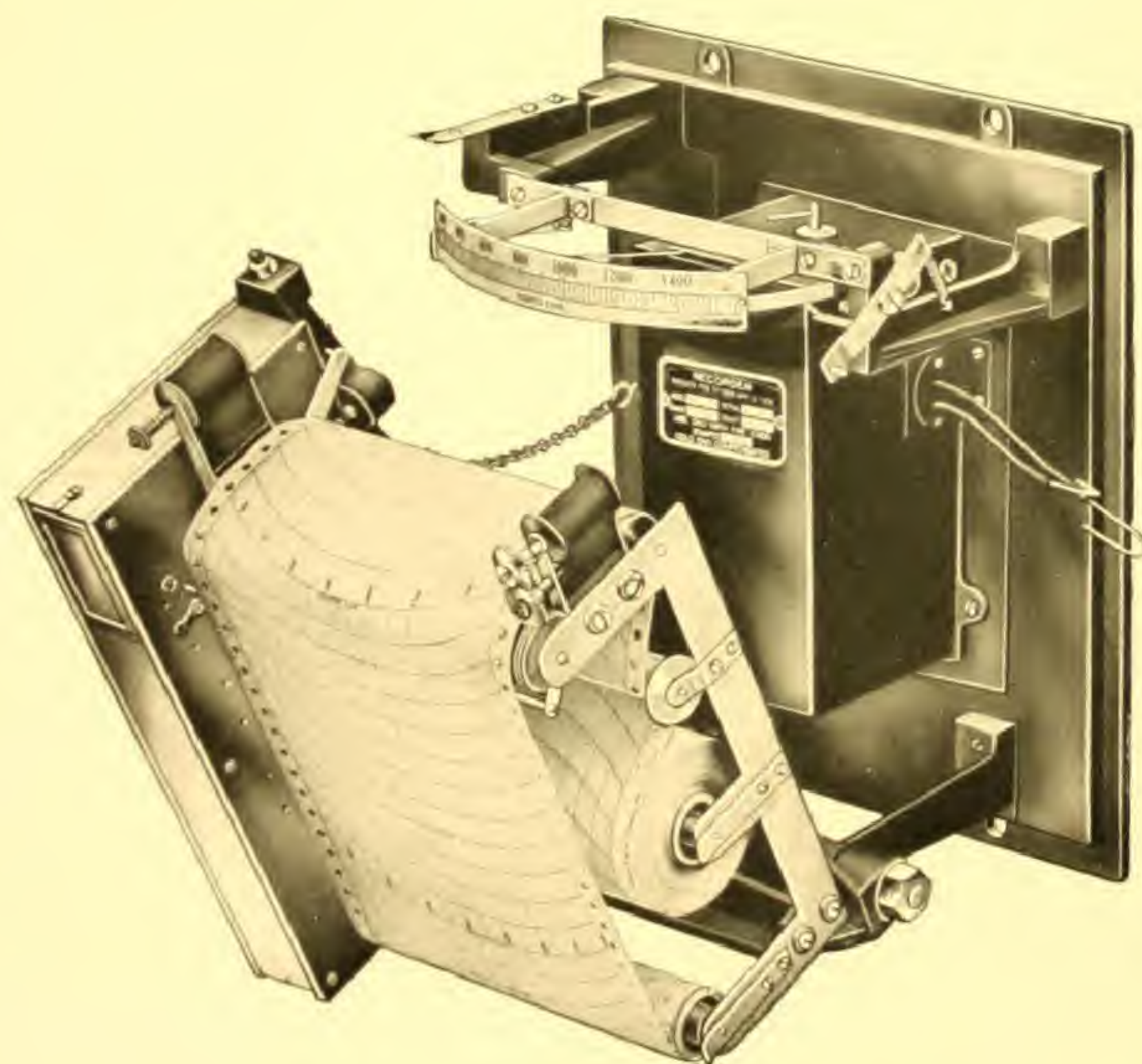


Figure 1493

### LIST PRICES

Pyrometer Instrument Model 425, Single Record, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard chart scale range selected from list. \$239.00

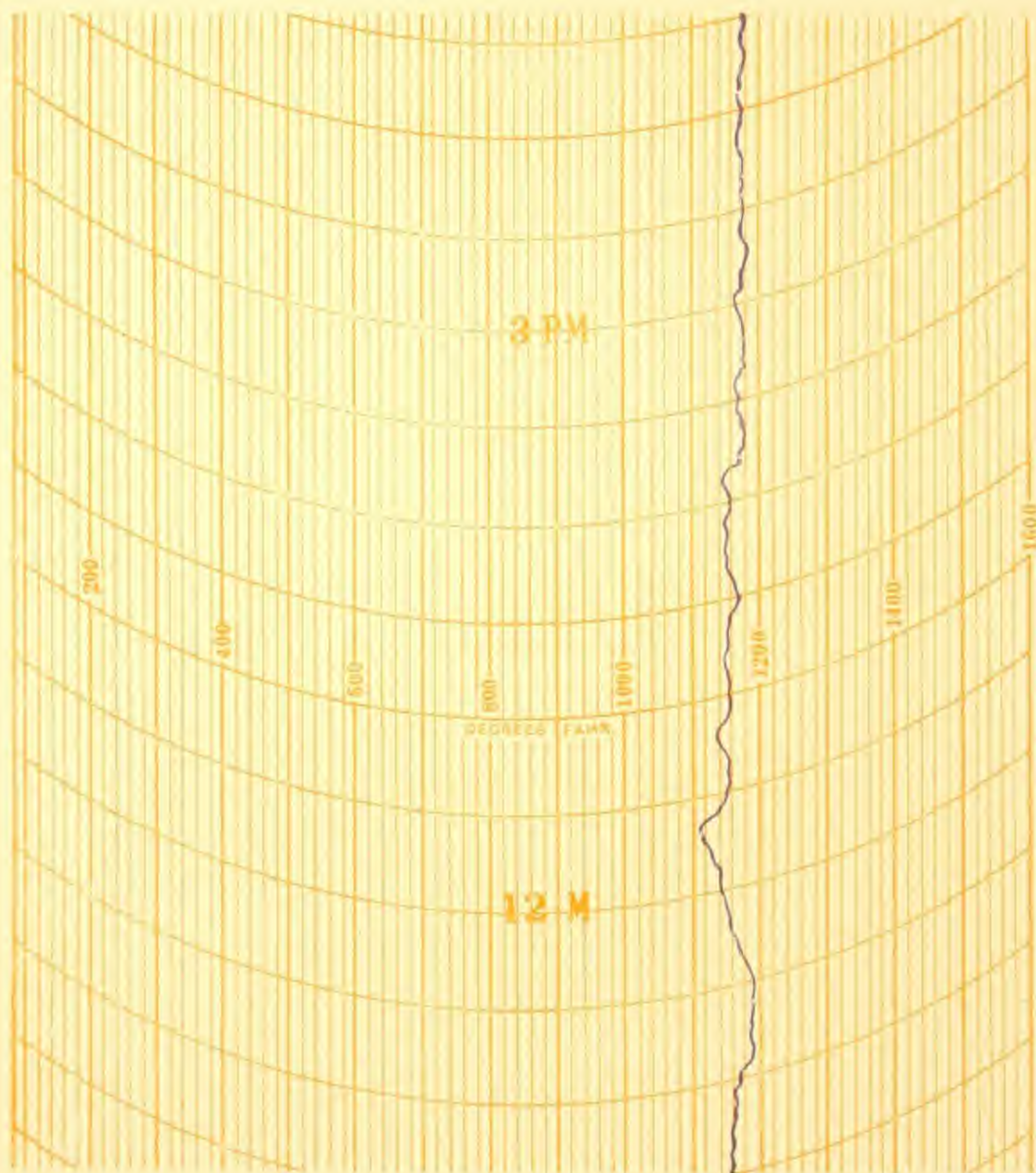
When calibrated to special chart scale range to order, there is an extra charge which will be quoted on request.

ELECTRICITY

MOTION, ETC.



## SPECIMEN STRIP CHART WITH RECORD



Full size section of Strip Chart with specimen record made with Recording Pyrometer Strip Chart, Single Record, Model 425. This chart has total range of 75 to 1600°F. Note that graduations are practically uniform, which is a characteristic of all Bristol's Pyrometer strip charts.



## STRIP CHARTS FOR USE WITH SINGLE RECORD PYROMETER MODEL 425

CHART No.	RANGE	CLOCK SPEED	FIRE-END MATERIAL
S-1123	0-1100°F.	1-Inch per Hr.	18B
*S-1152	500-1100°F.	1-Inch per Hr.	18B
S-1108	0-1600°F.	1-Inch per Hr.	18B
†S-1117	800-1600°F.	1-Inch per Hr.	18B
S-1154	0-1800°F.	1-Inch per Hr.	18B
S-1109	0-2000°F.	1-Inch per Hr.	18B
S-1158	0-1100°C.	1-Inch per Hr.	18B
S-1110	0-2100°F.	1-Inch per Hr.	25H
S-1116	0-2500°F.	1-Inch per Hr.	25H
S-1115	0-3000°F.	1-Inch per Hr.	27
S-1164	0-1650°C.	1-Inch per Hr.	27

\*\$5.00 extra list. †\$10.00 extra list.

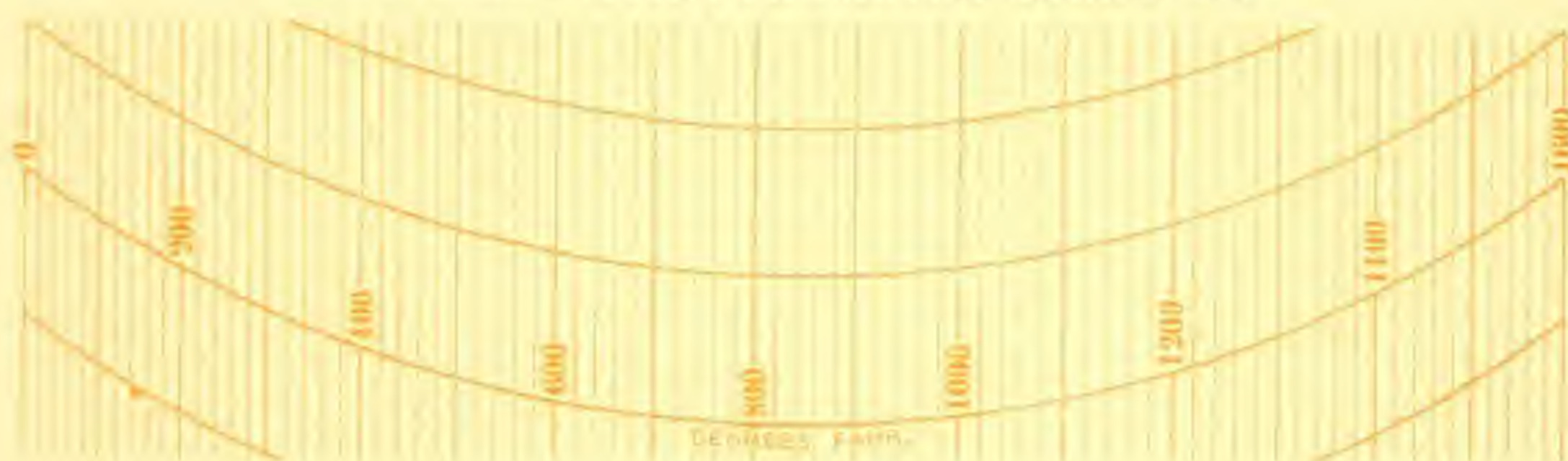
SPECIMEN SECTIONS OF SINGLE RECORD STRIP CHARTS  
AS USED WITH PYROMETER MODEL 425

Chart No. S-1108, Range 0 to 1600°F, Clock Speed 1-inch per hour, Fire-End Material 18-B.

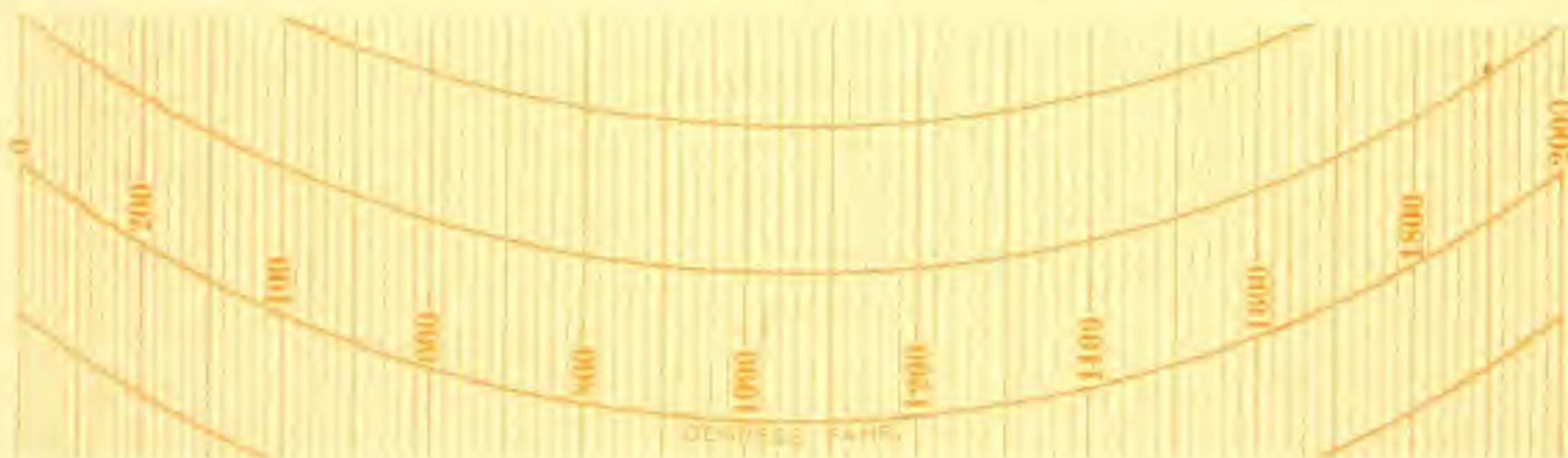


Chart No. S-1109, Range 0 to 2000°F, Clock Speed 1-inch per hour, Fire-End Material 18-B.



Chart No. S-1110, Range 0 to 2100°F, Clock Speed 1-inch per hour, Fire-End Material 25-H.

HUMIDITY

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U.S. PAT. OFFICE

## MULTIPLE FIRE-END RECORDING PYROMETER STRIP CHART, MODEL 425

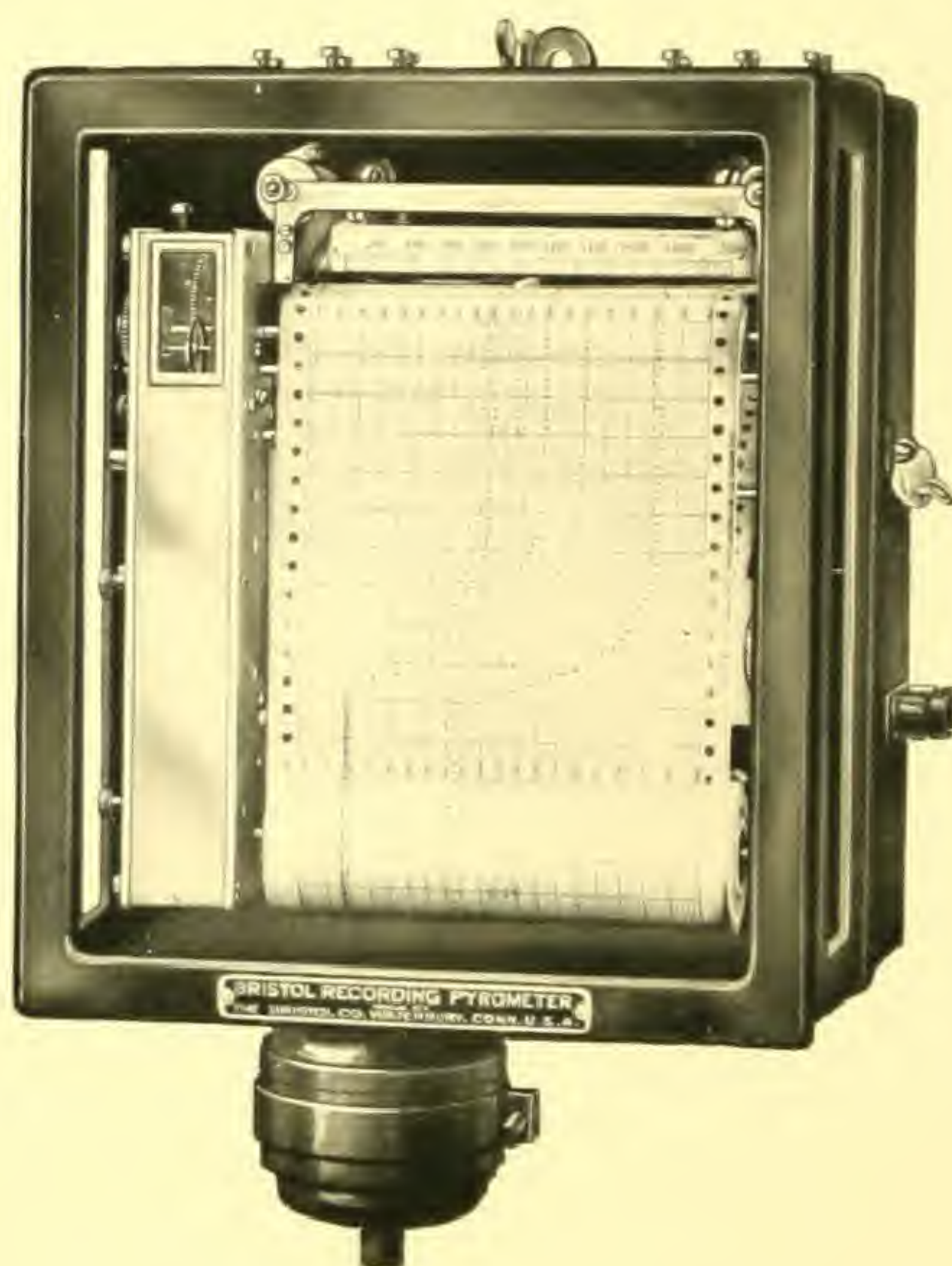


Figure 1564

This Multiple Record Instrument is furnished for two, three and six records. The recording medium used is a multi-colored ribbon, similar to that used on typewriter; a color for each fire-end connection.

The instrument in general is like the single record pyrometer; one measuring element and one recording-arm only are used. A motor driven selective switching device is employed to automatically make contact with each fire-end connection in rotation. Each connection remains in contact for forty-seconds, during which time the recording arm is pressed three times against the chart. Thus, with a six-point recording pyrometer the cycle is completed in 4-minutes, a three-point recorder every 2-minutes, and a two-point every 80-seconds. The motor used is a standard make and is operated from lighting circuit.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

## MULTIPLE FIRE-END RECORDING PYROMETER, STRIP CHART MODEL 425

The measuring element is a high resistance millivoltmeter, "Weston" make. This is equipped with Bristol's Patented Automatic Internal Cold-End Compensator which makes cold-end error an impossibility. A lever on top of the millivoltmeter movement provides easy zero adjustment.

Special heavy duty 8-day Bristol Clock is used to operate the chart, including feed-roll and rewind. The standard speeds is 1-inch per hour, with lever adjustment changing to 1-inch per minute. The clock is provided with stop and start button.

When desired an electrically driven clock can be furnished to use in place of the spring wound type. This has the advantage of no winding required, and for large installations where several recorders are used equipped with electric clocks, it is possible to have all charts operating in unison. The electric clock operates on alternating current where frequency is known to be constant, or where power system has synchronous frequency. It can be furnished to be used for 60, 50, 40 or 25 cycles. This also applies to the single and duplex models.

The case is made of metal and glass, with suitable packing which makes it both dust and damp-proof.

Detailed illustrations with explanations are shown on pages 30 and 31.

### LIST PRICES

Pyrometer Instrument, Multiple Fire-End Recording Model 425, for 2, 3, 4, 5 or 6 connections, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard chart scale range selected from list . . . \$361.00

When calibrated to special chart scale range to order, there is an extra charge which will be quoted on request.

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
 REG. U.S. PAT. OFFICE

## MULTIPLE FIRE-END RECORDING PYROMETER STRIP CHART, MODEL 425

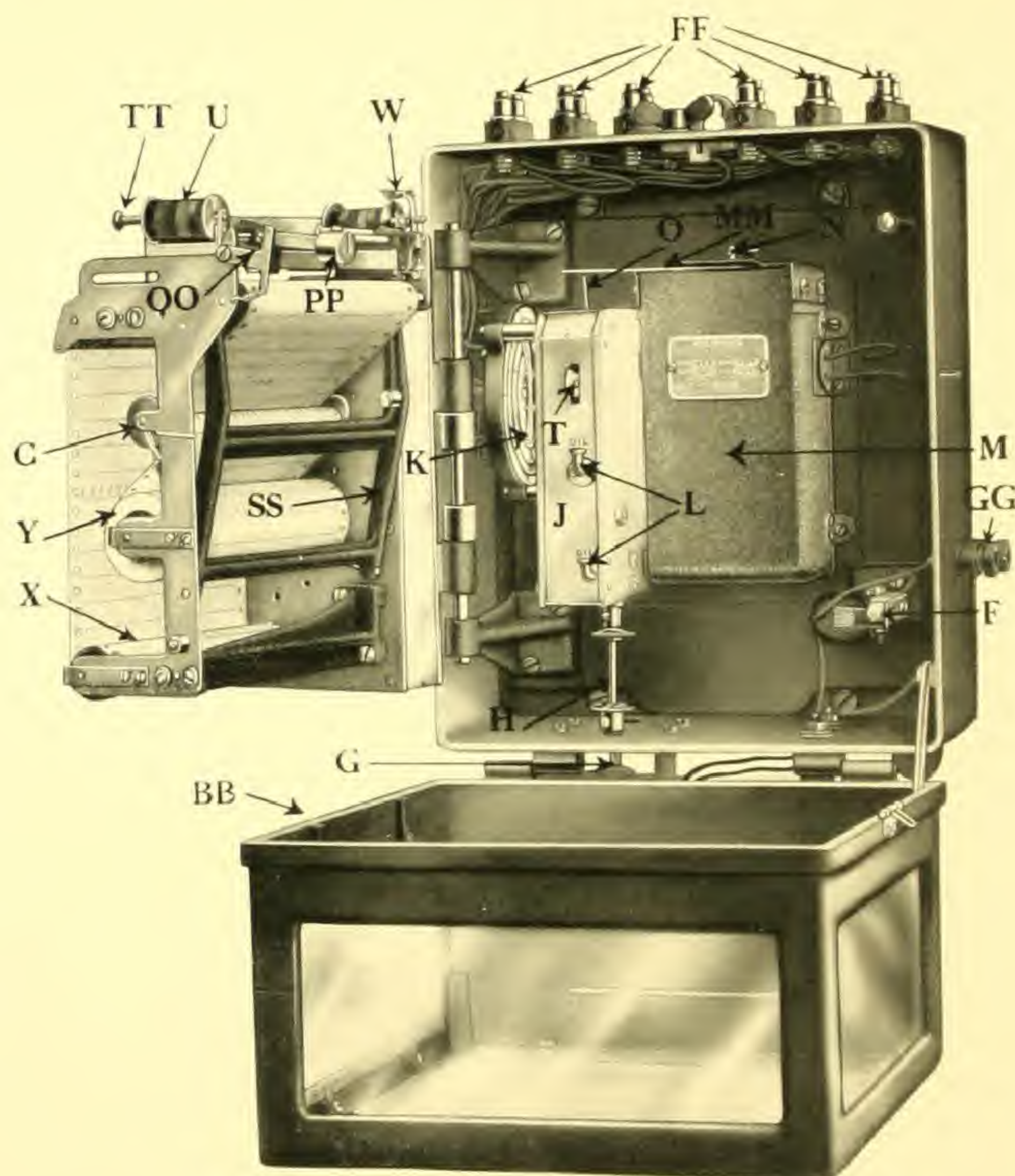


Figure 1844

- |      |                                               |      |                                      |
|------|-----------------------------------------------|------|--------------------------------------|
| A.   | Special heavy duty 8-day Bristol Clock        | F.F. | Fire-end binding posts               |
| B.   | Clock speed regulator                         | G.   | Electric motor                       |
| B.B. | Felt packing to make case dust and damp proof | G.G. | Electric motor binding posts         |
| C.   | Automatic paper tension device                | H.   | Motor drive shaft                    |
| D.   | Clock start and stop button                   | J.   | Speed reduction transmission case    |
| E.   | Chart drive roll                              | K.   | Heavy self-cleaning automatic switch |
| F.   | Clock element latch                           | L.   | Oil cups                             |



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

## MULTIPLE FIRE-END RECORDING PYROMETER STRIP CHART, MODEL 425

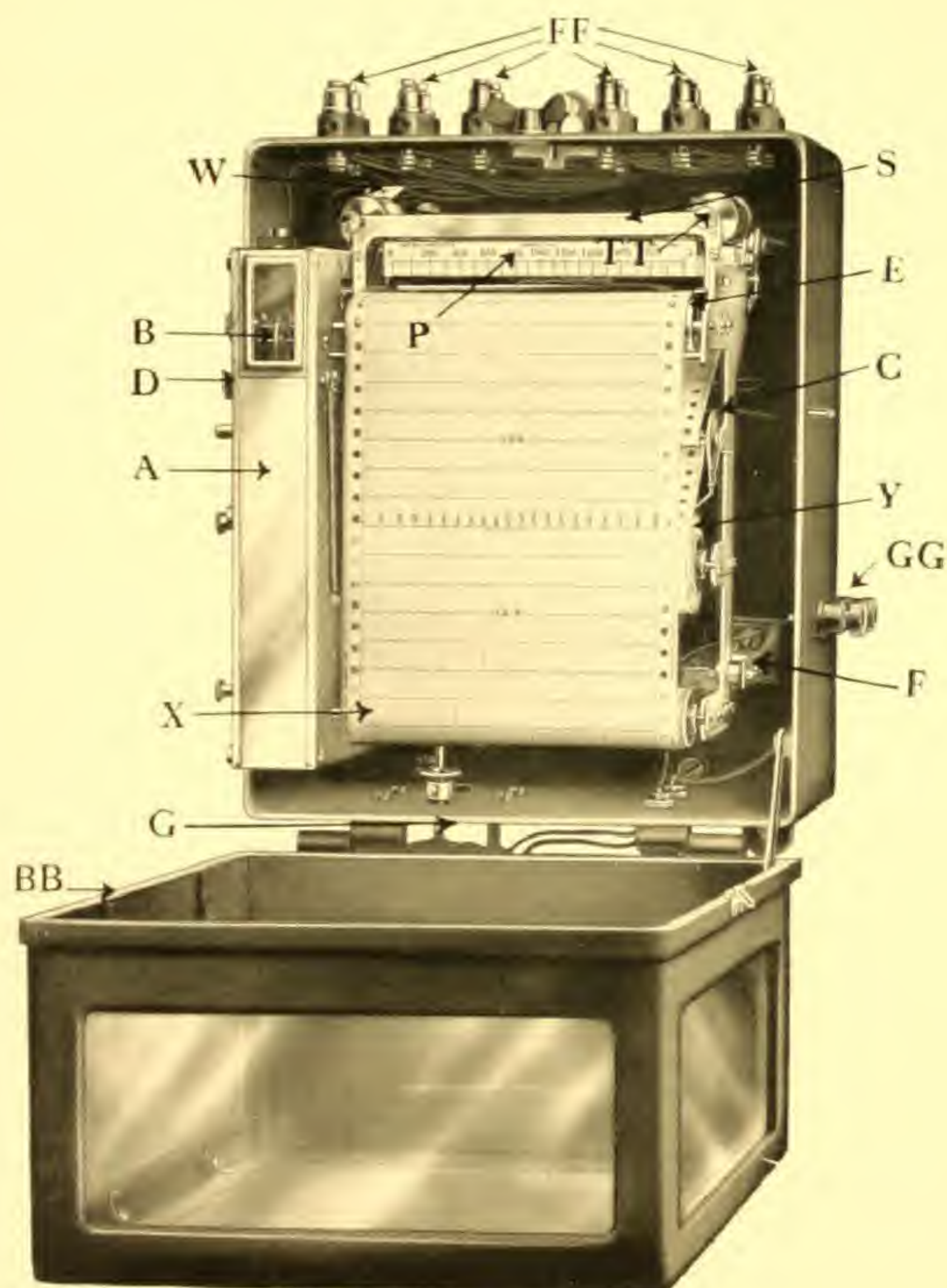


Figure 1845

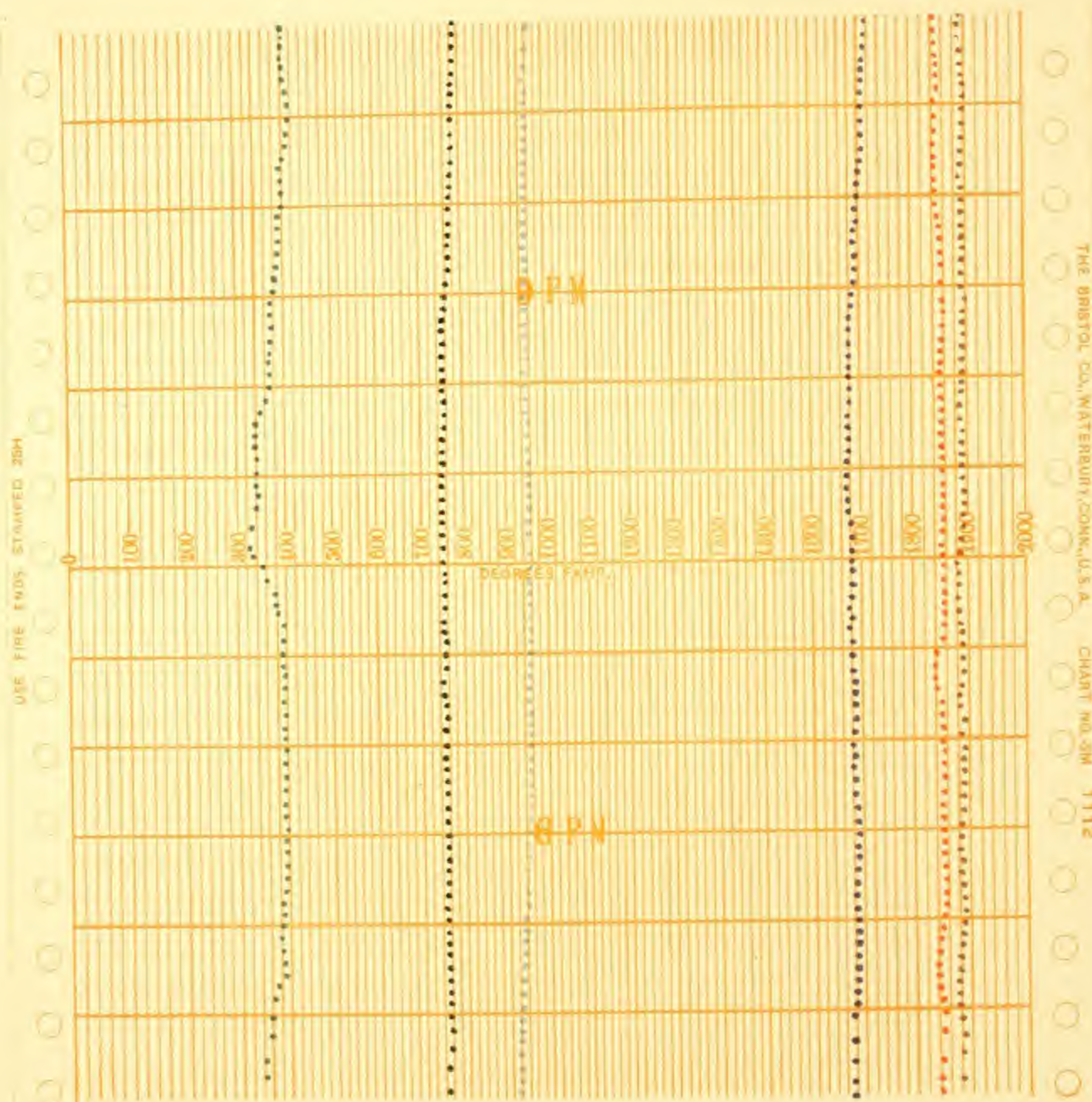
- |      |                                 |      |                       |
|------|---------------------------------|------|-----------------------|
| M.   | Weston Milli-Voltmeter Movement | S.S. | Ribbon carriage frame |
| M.M. | Milli-Voltmeter pointer         | T.   | Carriage cam shoe     |
| N.   | Zero adjustor                   | T.T. | Ribbon rewind knob    |
| O.   | Boom actuating lever            | U.   | Multi-colored ribbon  |
| O.O. | Automatic boom lifter           | W.   | Ribbon drive ratchet  |
| P.   | Indicating scale and boom       | X.   | Rewind chart roll     |
| P.P. | Boom counter weight             | Y.   | Stock chart roll      |
| S.   | Ribbon carriage                 |      |                       |

ELECTRICITY

MOTION, ETC.



# **SPECIMEN CHART WITH RECORD MADE WITH 6-POINT MULTIPLE FIRE-END RECORDING PYROMETER**



A section of chart with records of Brick Kiln temperatures made by six-point Bristol's Multiple Fire End Recording Pyrometer, Strip Chart Model 425. This illustrates how well the color scheme brings out the individual records. Although the records shown here run parallel, they are just as easily distinguished if they are more irregular and cross each other.

The arrangements for colors used are: Six-point Recorder—Blue, Red, Green, Brown, Purple, and Black; Three-point Recorder—Red, Green, and Black; Two-point Recorder—Red and Black.



### STRIP CHARTS FOR USE WITH MULTIPLE FIRE-END RECORDING PYROMETER MODEL 425

CHART NO.	RANGE	CLOCK SPEED	FIRE-END MATERIAL
SM-1147	0-800° F.	1-Inch per Hr.	18B
SM-1128	0-1100° F.	1-Inch per Hr.	18B
SM-1120	0-1600° F.	1-Inch per Hr.	18B
*SM-1107	700-1700° F.	1-Inch per Hr.	18B
SM-1122	0-2000° F.	1-Inch per Hr.	18B
SM-1155	0-1100° C.	1-Inch per Hr.	18B
SM-1112	0-2000° F.	1-Inch per Hr.	25H
†SM-1159	1000-2000° F.	1-Inch per Hr.	25H
SM-1125	0-2500° F.	1-Inch per Hr.	25H
SM-1130	0-1100° C.	1-Inch per Hr.	25H
SM-1131	0-1375° C.	1-Inch per Hr.	25H

\*\$5.00 extra list. †\$10.00 extra list

### SPECIMEN SECTIONS OF STRIP CHART AS USED WITH MULTIPLE FIRE-END PYROMETER MODEL 425

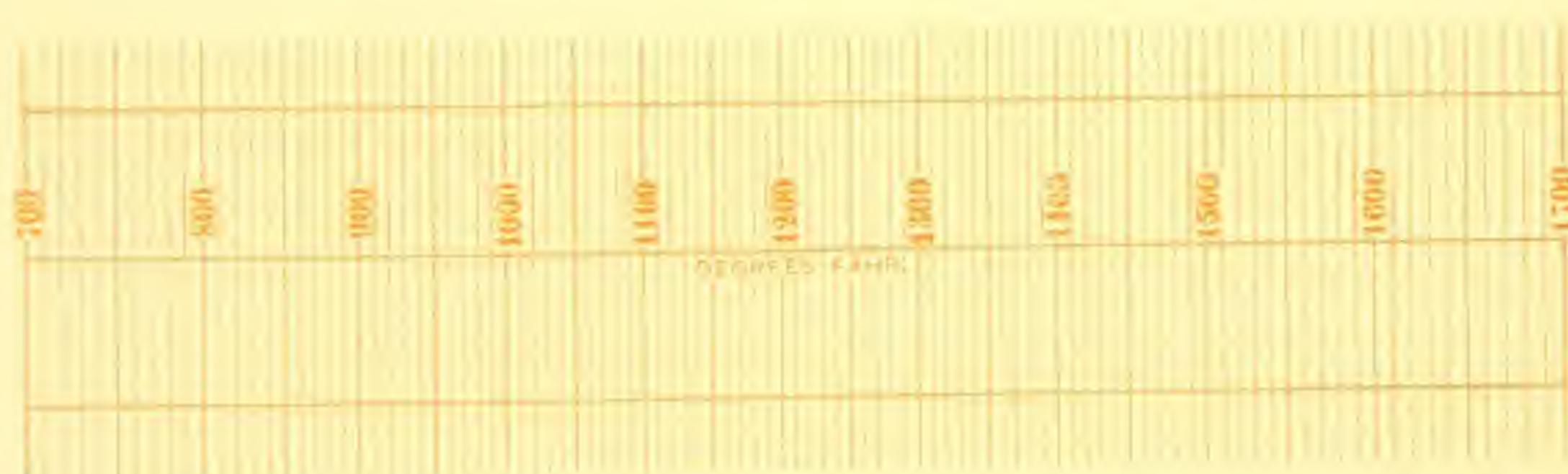


Chart No. SM-1107, Range 700 to 1700°F, Clock Speed 1-inch per hour, Fire-End Material 18-B.



Chart No. SM-1112, Range 0 to 2000°F, Clock Speed 1-inch per hour, Fire-End Material 25-H.

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
 REG. U.S. PAT. OFFICE

## DOUBLE-MOVEMENT DOUBLE-RECORD RECORDING PYROMETER, STRIP CHART, MODEL 425



Figure 1837

This Double Record Pyrometer is especially suitable for comparative records of two furnaces or for two locations in the same furnace.

The construction of the instrument is same as the Single Record Pyrometer, except that there are two complete recording systems operating entirely independent of each other. This allows two parallel records on the same chart without overlapping. See specimen chart with record on page 36.

A specially built 8-day clock operates the chart roll and recording vibrator.

The chart used is 90-feet long and the standard speed 1-inch per hour, provides a continuous record for 45-days duration.

### LIST PRICES

Pyrometer Instrument, Double-Record Double-Movement Model 425, equipped with Automatic Internal Cold-End Compensator, and calibrated for standard chart scale range selected from list... \$278.00  
 When calibrated to special chart scale range to order, there is an extra charge which will be quoted on request.



### STRIP CHART FOR USE WITH DOUBLE-MOVEMENT DOUBLE-RECORD RECORDING PYROMETER MODEL 425

CHART No.	RANGE		CLOCK SPEED	FIRE-END MATERIAL
SD-1129	0-800° F.	0-800° F.	1-Inch per Hr.	18B
*SD-1151	400-1000° F.	400-1000° F.	1-Inch per Hr.	18B
SD-1132	0-1100° F.	0-1100° F.	1-Inch per Hr.	18B
SD-1111	0-1600° F.	0-1600° F.	1-Inch per Hr.	18B
*SD-1118	800-1800° F.	800-1800° F.	1-Inch per Hr.	18B
SD-1113	0-1800° F.	0-1800° F.	1-Inch per Hr.	18B
†SD-1150	1000-2000° F.	1000-2000° F.	1-Inch per Hr.	18B
SD-1124	0-2000° F.	0-2000° F.	1-Inch per Hr.	18B
SD-1134	0-1100° F.	0-1100° F.	1-Inch per Hr.	25H
*SD-1156	800-1800° F.	800-1800° F.	1-Inch per Hr.	25H
SD-1119	0-2000° F.	0-2000° F.	1-Inch per Hr.	25H
SD-1144	0-2500° F.	0-2500° F.	1-Inch per Hr.	25H
SD-1138	0-1100° C.	0-1100° C.	1-Inch per Hr.	25H
SD-1121	0-3000° F.	0-3000° F.	1-Inch per Hr.	27

\*\$10.00 extra list †\$20.00 extra list

### SPECIMEN SECTIONS OF STRIP CHARTS FOR USE WITH DOUBLE-MOVEMENT DOUBLE-RECORD RECORDING PYROMETER MODEL 425

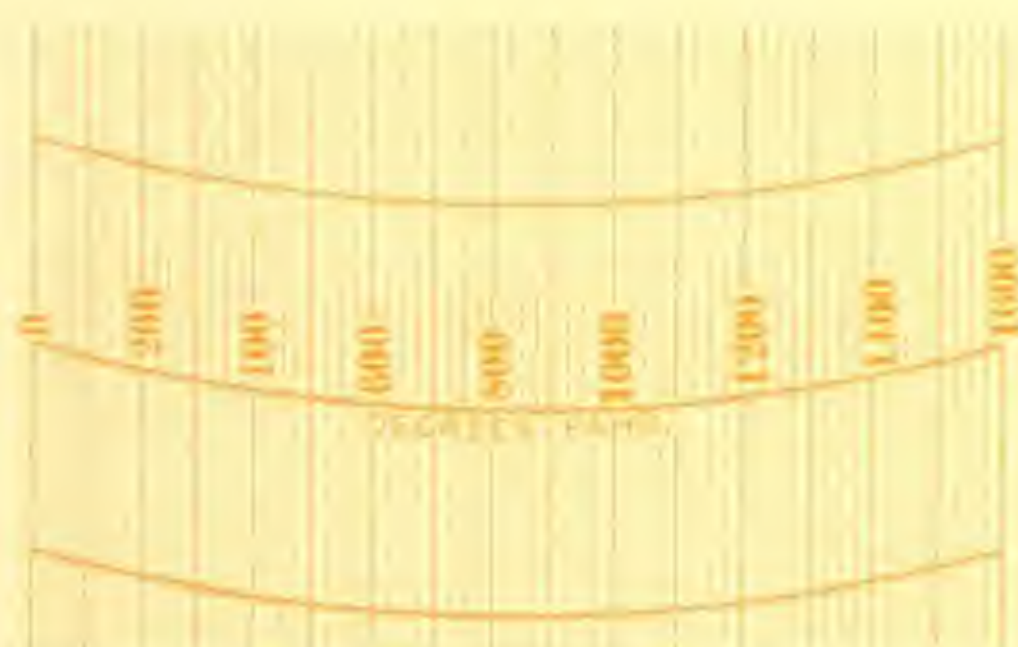


Chart No. SD-1111, Range 0 to 1600° F., Clock Speed 1-inch per hour, Fire-End Material 18B.

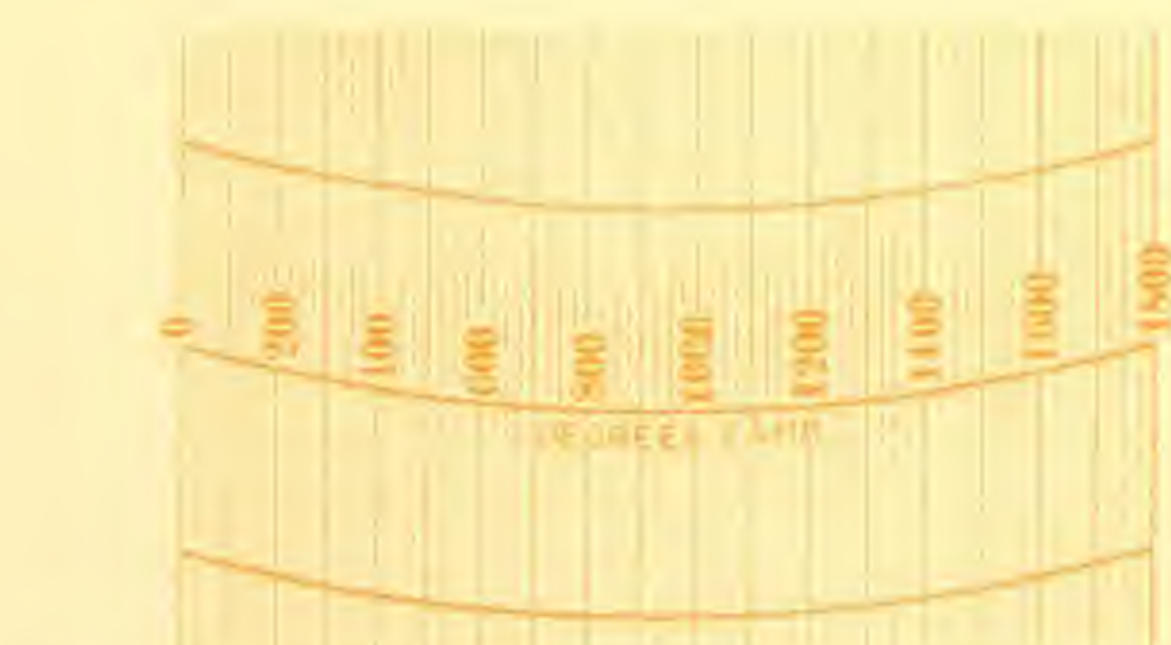
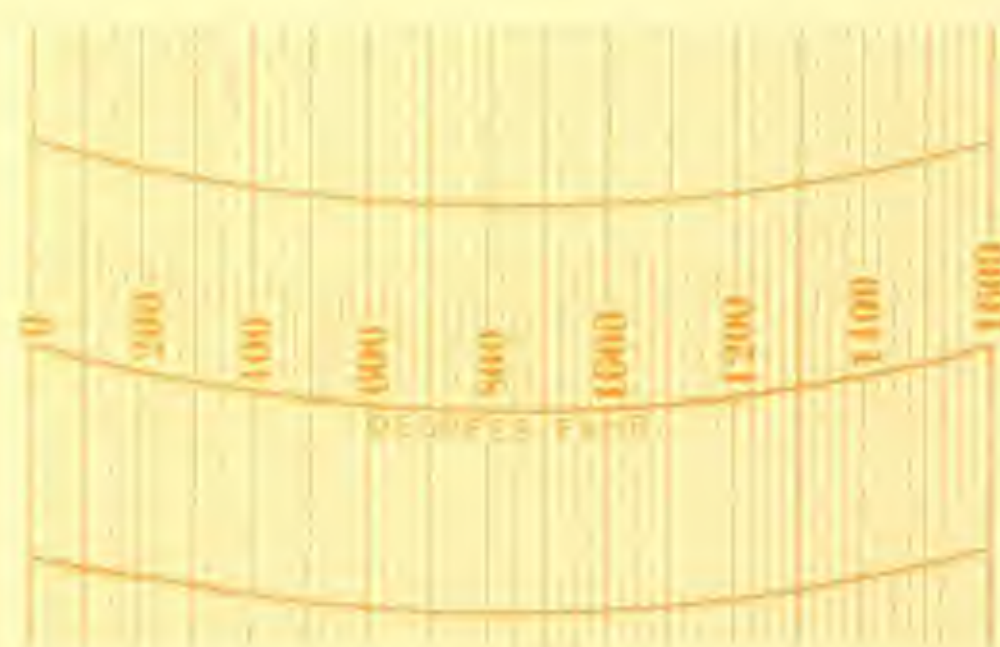
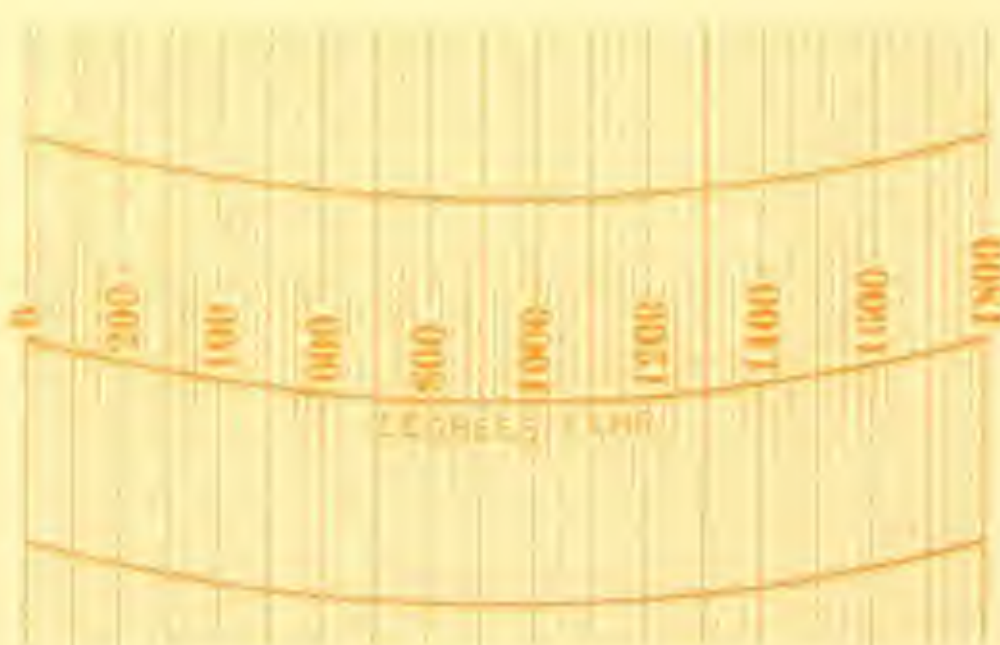


Chart No. SD-1113, Range 0 to 1800° F., Clock Speed 1-inch per hour, Fire-End Material 18B.



ELECTRICITY

MOTION, ETC.



## SPECIMEN CHART WITH RECORD MADE BY DOUBLE-MOVEMENT DOUBLE-RECORD PYROMETER

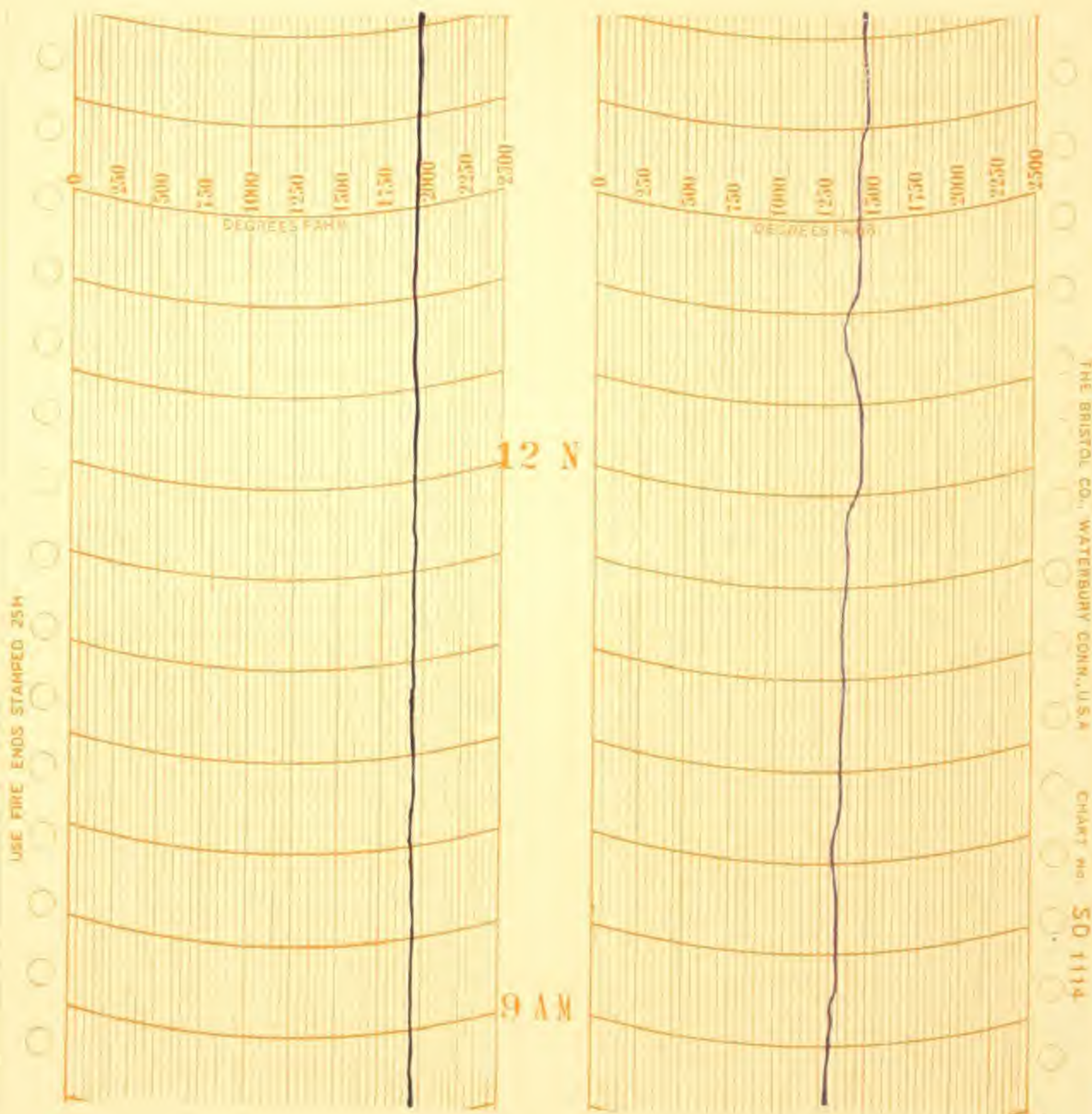


Figure 1861

The double scale chart for some applications is equally efficient as using individual instruments for each operation. Above specimen records are simultaneous temperatures of two separate brick kilns.



## PROTECTION CASES

It is often necessary to install a Pyrometer instrument where it is exposed to dust and dirt, moisture, chemical fumes, or sudden blasts of heat and cold. Where these conditions exist, it is advisable to furnish an extra protection for the pyrometer instrument, in the form of Wooden Cases, like those shown here.

The mechanical protection from injury due to dirt, etc., is important. But Wood is also a non-conductor of heat, therefore, the protection case partially insulates the instrument from sudden changes of external temperatures, and thus facilitates the internal functions also employed to counteract such changes.

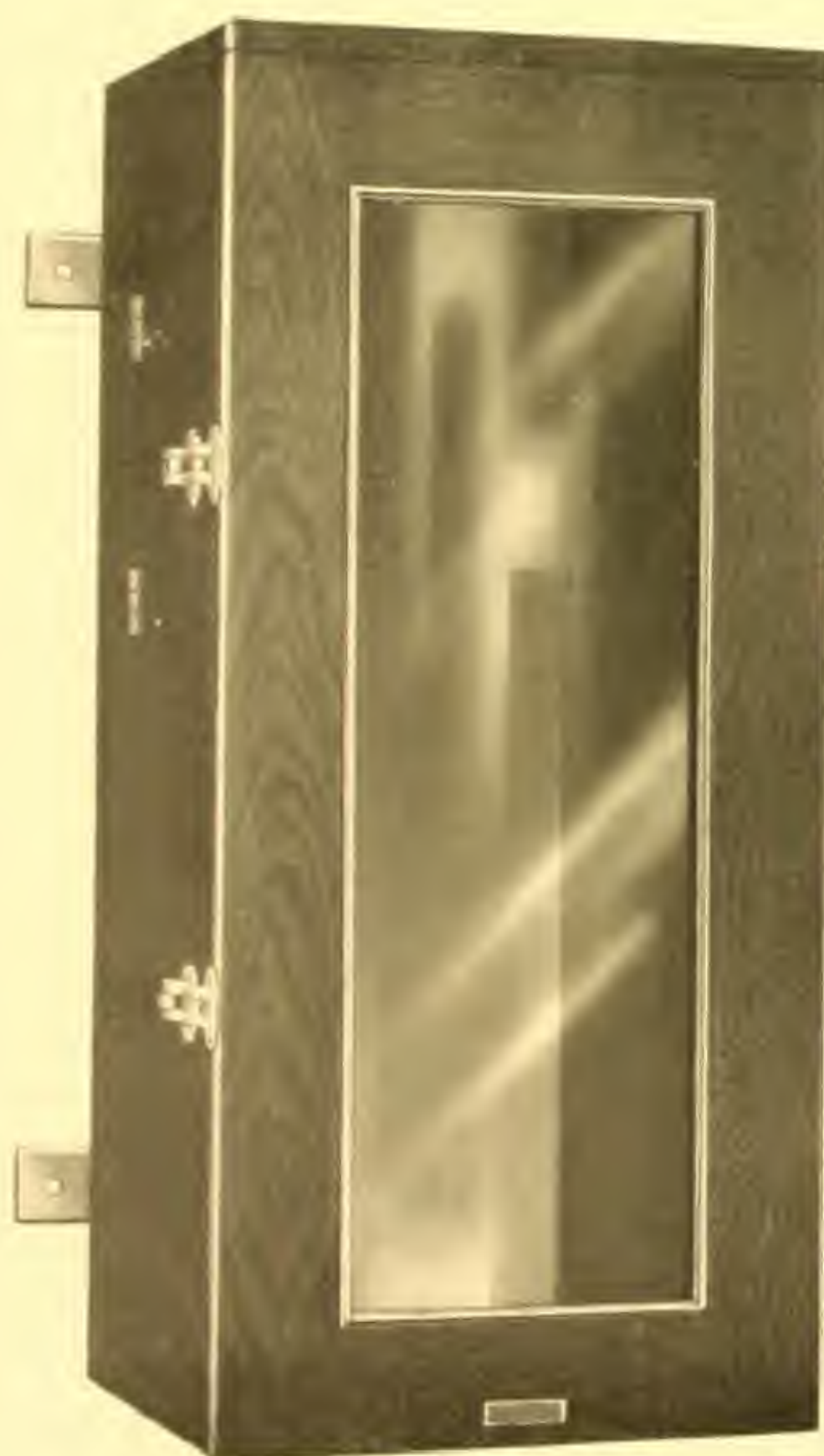


Fig. 2576  
For Strip Chart Recorder Model 425



Fig. 2575  
For Indicating Model 420



Fig. 2574  
For Indicating Model 410

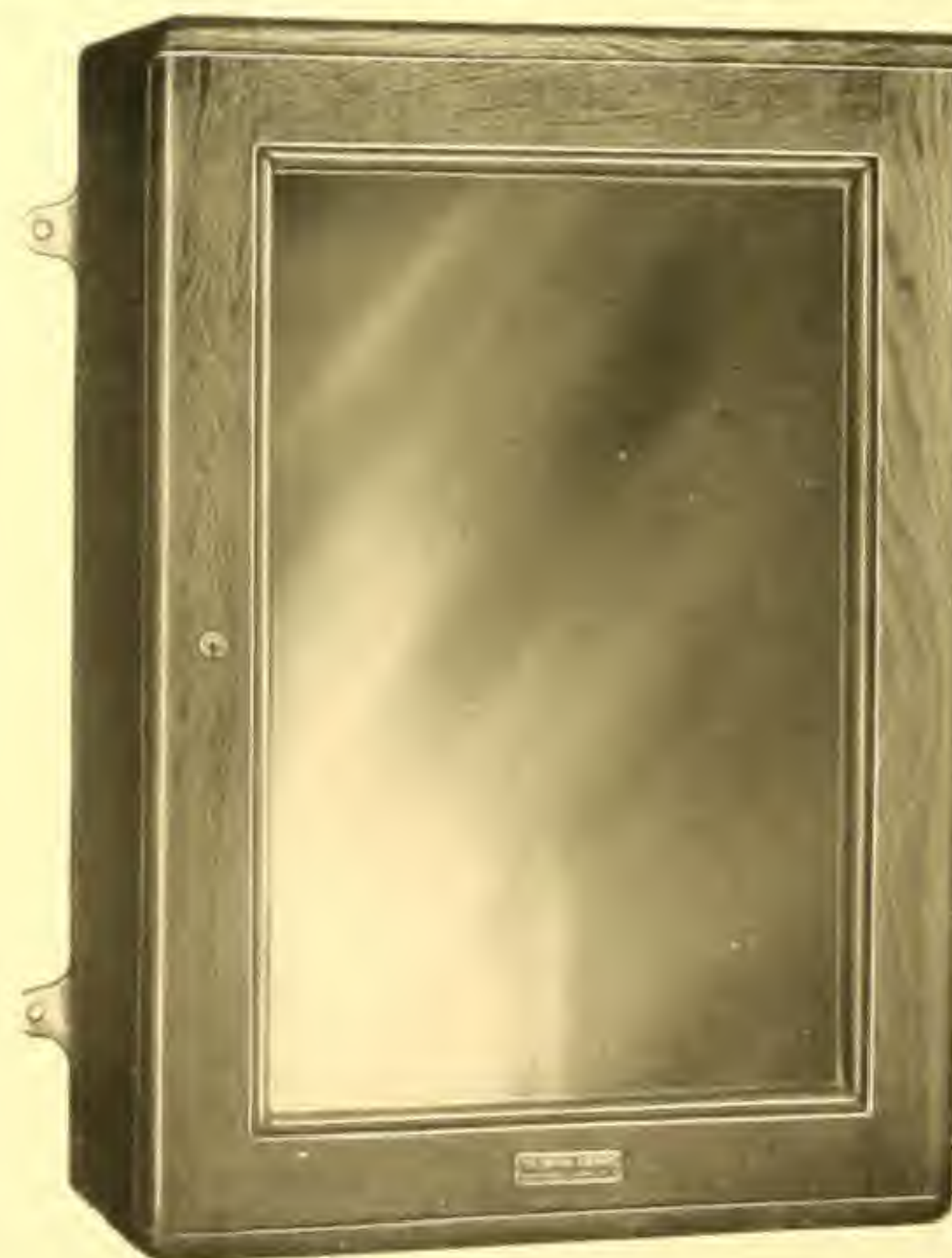


Fig. 2573  
For Round Chart Recorder Model 437

## LIST PRICES

### WOODEN PROTECTION CASES AS ILLUSTRATED ABOVE:

For Use With Model 425	\$30.00
Model 437	15.00
Model 410	11.00
Model 420	15.00

ELECTRICITY

MOTION, ETC.



## ONE PYROMETER USED FOR TAKING READINGS OF MORE THAN ONE TEMPERATURE

There are some processes where it is not required to have pyrometer in continuous operation, but only occasional records or intermittent readings are necessary. For such conditions the various switch devices described here are used to advantage.

### TWO WAY LEVER SWITCH

The simplest form of switch equipment is the two-point lever switch as shown used in connection with the indicating pyrometer. For this the pyrometer is equipped with two sets of terminals and connected through the switch so that readings of temperatures in two different locations may be had by simply throwing lever from one to the other.

As a practical example, it is often desirable to use one pyrometer with two thermo-couple connections; one for the lead bath, the other for high speed furnace; or again, one for temperature of carbon steel and the other for high speed steel furnace.

**LIST PRICE**—Two Way Lever Switch quoted on request.



Fig. 2551  
Two Way Lever Switch Used With  
Indicating Pyrometers

## MULTIPLE ROTARY SWITCH



Fig. 2552  
20-Point Rotary Switch

When temperature readings for more than two different locations are desired to be taken with one pyrometer instrument, then multiple rotary switch offers a very convenient method for connecting the instrument with the different fire-ends.

The Diesel Engine Exhaust is one illustration where such an equipment is used. Also where there are a number of furnaces with which the continuous use of a pyrometer is not required. Then again for flue gas temperatures in connection with a battery of boilers.

This style of switch can be furnished for 5, 10 and 20 connections. Should more than 20 connections be desired, a second switch can be furnished having numbers etched on dial reading from 21 and up.





Fig. 2550  
Rotary Switch Used With  
Indicating Pyrometer

The case for Bristol's Rotary Switch is water-proof. The whole construction is thoroughly insulated and connections made by means of double-break, self-cleaning contact, thus positively eliminating any difficulties resulting from short circuit.

The Bristol's Indicating Pyrometer Model 420 mounted in wooden protection case with self-contained panel extension on which is shown mounted a 10-point rotary switch, is a neat and convenient arrangement and suggests the possibilities for pyrometer unit with switch equipment.

Although the illustrations shown here are with Indicating Pyrometer Instruments the same idea can be used with Recorders.

#### LIST PRICES

Bristol's Rotary Switch, 5-point.....	\$25.00
Bristol's Rotary Switch, 10-point.....	30.00
Bristol's Rotary Switch, 20-point.....	40.00

### PLUG TYPE MULTIPLE SWITCH BOARD

This is another type of switch equipment which can be used with Bristol's Indicating or Recording Pyrometers. The switchboard can be furnished for 5, 10, 20 or 40 separate connections. The one illustrated is arranged for 20.

In using this switchboard, there is only one way in which the plug can be inserted into the receptacle. Thus there is no possible chance for confusion of polarity. The outfit is very compact and requires little space. The case is of wood, and dust-proof, also fitted with lock and key so that only responsible parties can have access.



Fig. 1545

#### LIST PRICES

Bristol's Multiple Switchboard Plug Type in Wooden Protection Case with 5-foot Extension Lead and Polarity Plug:		
Plug Type Switchboard, complete as above	5-point.....	\$45.00
" " " " " "	10-point.....	50.00
" " " " " "	20-point.....	80.00
" " " " " "	30-point.....	90.00
" " " " " "	40-point.....	100.00

ELECTRICITY

MOTION, ETC.



## THE CLOCK USED WITH BRISTOL'S RECORDERS

While the penarm is recording on the chart, a clock movement is used to revolve the chart so that not only the temperatures can be read but the time at which they occur is also shown.

### SPRING WOUND CLOCK

The clock regularly furnished with Bristol's Recorders is of the spring wound type, specially designed for the work. It is rarely that these clocks fail to operate except for very unusual causes. In such instances they can be easily removed from the case and returned for replacement or repair.

### MOTOR OPERATED CLOCKS

In place of the spring wound clock, Bristol's Pyrometers can be furnished equipped with electrically operated clock. This not only eliminates the necessity for winding, but when several recorders are used equipped with the electric clocks, it is possible to have all charts operating in unison.

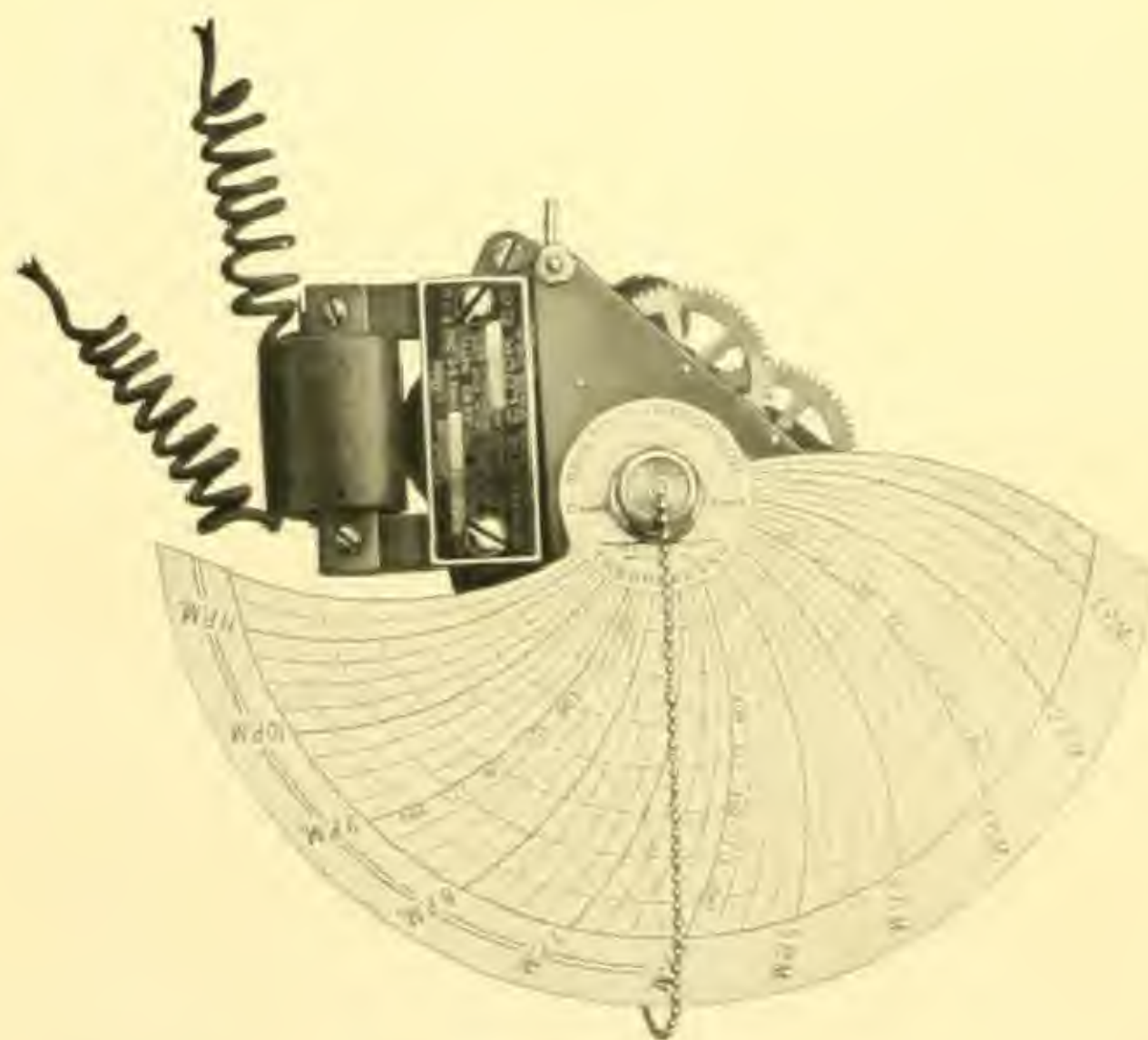


Fig. 2467

Motor Operated Clock used with Round Chart Instruments. This Clock can be furnished for 24-hour or 7-day revolutions.

The electric clock furnished with Bristol's Recorders is the Warren Motor Clock. It operates on alternating current where frequency is known to be constant or where power system has synchronous frequency. It can be furnished to use for 60, 50, 40 or 25 cycles.



Fig. 2583

For use with Strip Chart Instruments the Motor Operated Clock shown here can be had for 3, 6 or 12-inch per hour speeds.

Prices for Instruments equipped with Electric Clock will be furnished on request.



## LEADS



Figure 529

Patented Separable Connection for Fire-End and Couple Extension (Joined).

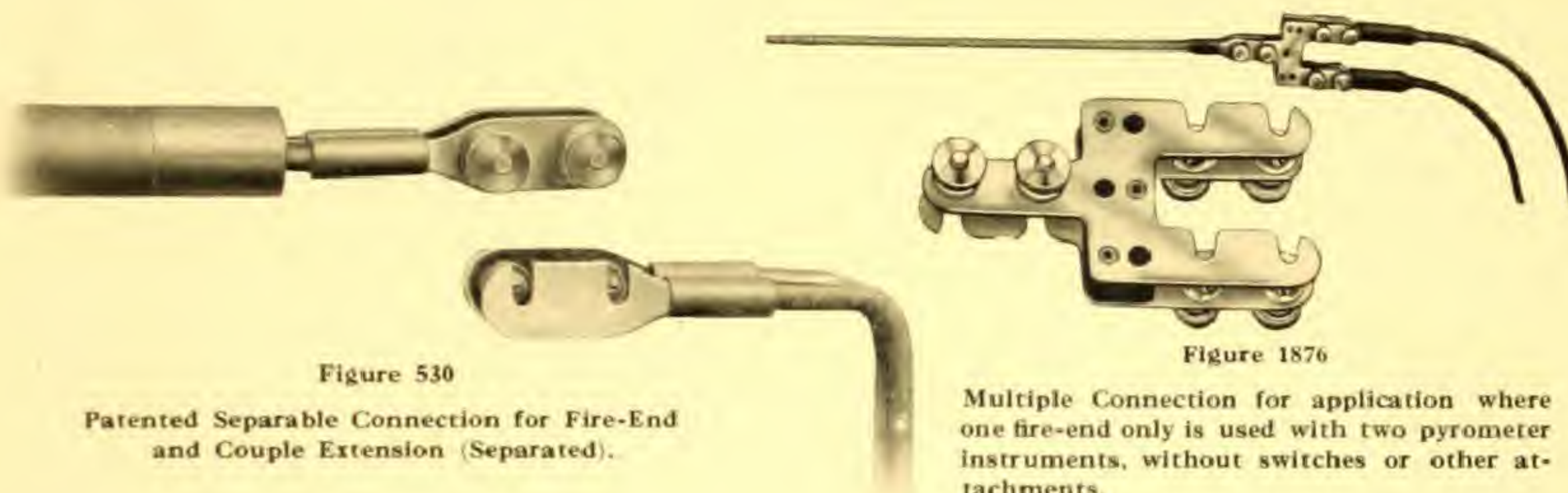


Figure 530

Patented Separable Connection for Fire-End and Couple Extension (Separated).

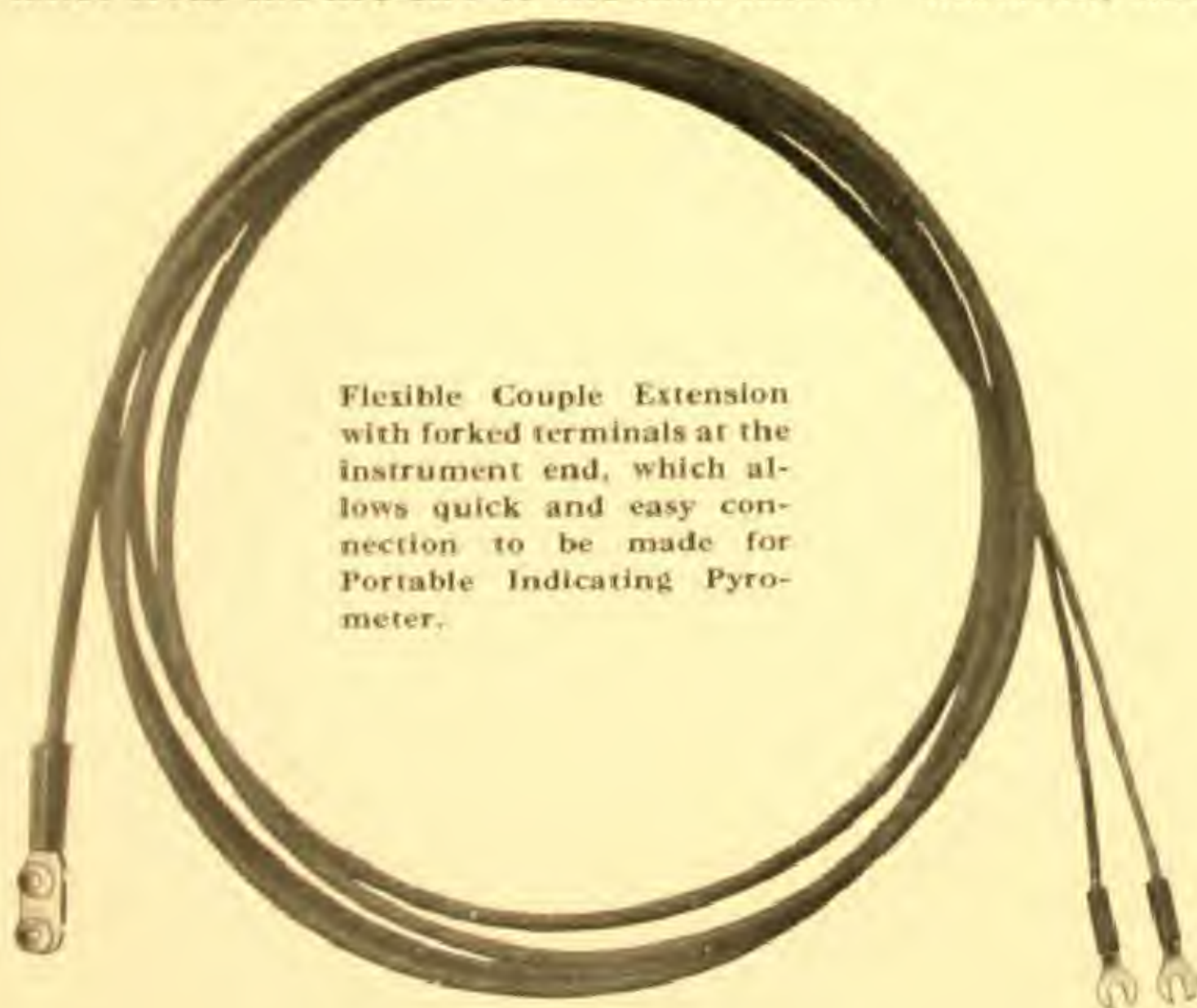
Figure 1876

Multiple Connection for application where one fire-end only is used with two pyrometer instruments, without switches or other attachments.

The term "Lead" is a general one applied to the duplex wire connection, used between the Pyrometer instrument and the Fire-End. These leads, however, are divided into two classes; first, those made of the same materials as the fire-end and always referred to as "Couple Extension"; second, those made of copper wire and called "Copper Leads". This distinction should be kept clearly in mind. The couple extension is used to carry the cold-end away from the fire-end, and with the Automatic Internal Cold-End Compensator, it is used the entire distance from the fire-end to the instrument. Material, size of wire, length, insulation and protection are all taken into consideration when furnishing the correct lead to be used.

Bristol's Leads consist of properly selected wire in duplex form, encased in a single covering, and supplied with convenient means for making terminal connections. When run through a conduit or otherwise permanently installed, solid wire is used. Where the lead is subjected to considerable handling, as at the terminal ends of permanent installations, with portable instruments, etc., stranded wire is used, because it affords greater flexibility without danger of breaking.

It is occasionally necessary to remove the fire-end from the couple extension. To make this easy without disturbing other parts of the



Flexible Couple Extension with forked terminals at the instrument end, which allows quick and easy connection to be made for Portable Indicating Pyrometer.

Figure 1785

ELECTRICITY

MOTION, ETC.



## LEADS

equipment, a very efficient terminal connection is supplied, see Figures Nos. 529 and 530. This is a patented feature known as Separable Fire-End Connection, and is so designed that it can be put together in only one way. Thus, making it impossible to connect the fire-end and couple extension with reversed polarity. This is very important, and just another instance where the details of Bristol's Pyrometer equipment is carried out on the fool-proof plan.

The terminals at the instrument end are of various forms to suit the particular needs. These are shown and described in connection with the illustrations on pages 41, 42 and 43.

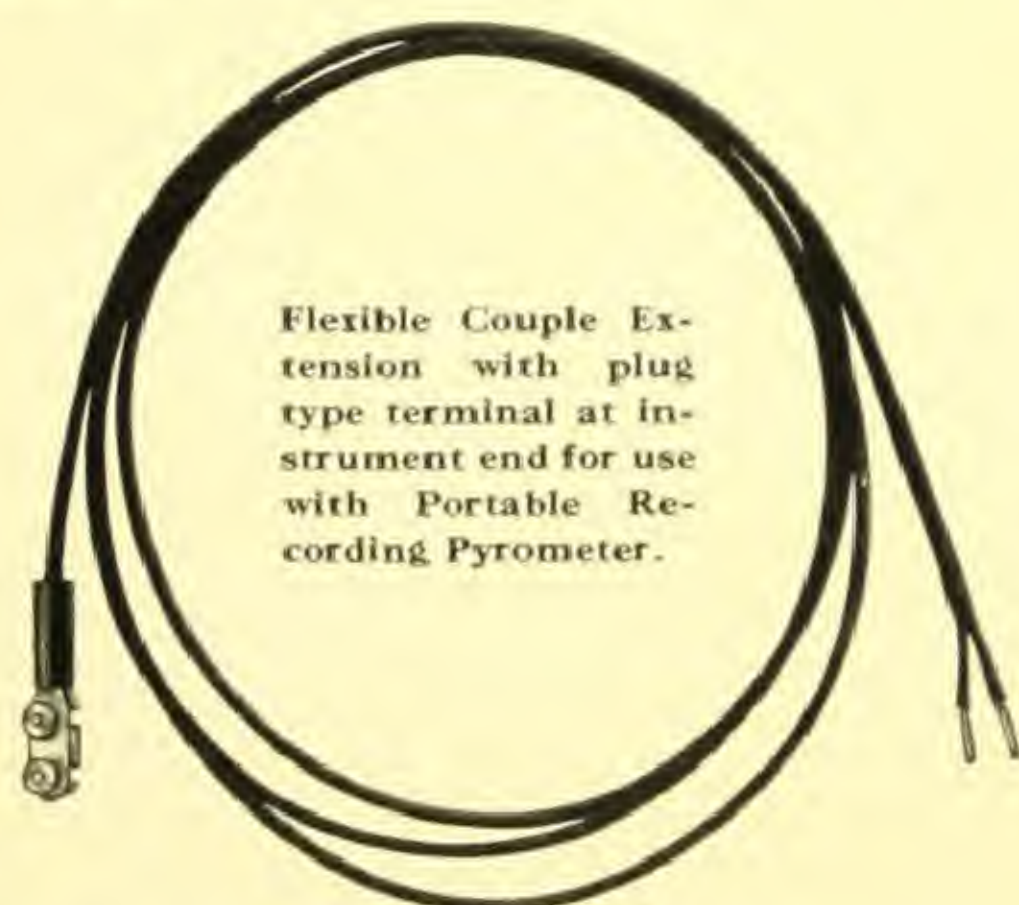


Figure 1788

of the thermo-couple away from the higher temperatures surrounding the furnace, to a point of constant temperature, or where changes in temperature are compensated for. The insulation of the Couple Extension consists of a composition of asbestos and other materials, which are heat-proof and moisture-proof. The electrical insulation of the Copper lead is rubber. This is usually satisfactory, because the Copper Leads are not recommended for installation where they will be exposed to high temperatures.

To take care of the varied conditions under which it is necessary to use Pyrometer leads, several



Figure 1786

The resistance in the lead is determined by the size and length of wire. Thus, the distance between the fire-end and instrument is limited only by the size of wire available. In actual practice a distance of several hundred feet is possible. A very significant fact in regard to Bristol's Pyrometer Leads is that they are standardized with respect to resistance, regardless of length. Therefore, it is possible to use the Pyrometer instrument interchangeably without affecting the accuracy of the equipment. This is an especially important feature where instruments are being used by inexperienced help.

Couple Extension leads are used at the fire-end terminals, sufficient in length to carry the cold-end



Figure 1787

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## LEADS



Flexible Bronze Armor provides extra mechanical protection for Extension or Leads.

Figure 1784

kinds of exterior protections are offered. Rubber covered with woven fabric for normal conditions of temperature and atmosphere. Asbestos covered where exposed to higher temperatures. Lead covered where subjected to action of chemical fumes which would deteriorate other materials. Flexible Bronze Armor is offered as an additional mechanical protection from injury due to rough handling. Particularly adapted for use at the furnace end, between the conduit and fire-end.

## LIST PRICES

COUPLE EXTENSION (Leads) are always used with Bristol's Pyrometers having Patented Automatic Internal Cold-End Compensator. The prices given here do not include calibration and terminals.

## FLEXIBLE DUPLEX (Stranded) COUPLE EXTENSION—Uncalibrated:

Asbestos Covered	\$ .22 per ft.
Lead Covered	.32 " "

## DUPLEX (Solid) COUPLE EXTENSION—Uncalibrated:

Rubber Covered	.12 " "
Lead Covered	.22 " "

Prices will be quoted on request for large quantity requirements of Extension Leads for Pyrometer installations.

COPPER (Leads) are used only for Pyrometer installations when instrument is furnished without Automatic Compensator. The prices given here do not include calibration and terminals.

## FLEXIBLE DUPLEX (Stranded) COPPER LEAD—Uncalibrated:

Size No. 14 Wire, Rubber Covered	\$ .06 per ft.
" " 12 " " "	.08 " "
" " 10 " " "	.10 " "
" " 14 " Asbestos Covered	.15 " "
" " 14 " Lead Covered	.17 " "
" " 12 " " "	.19 " "
" " 10 " " "	.21 " "

FLEXIBLE BRONZE ARMOR PROTECTION, as shown in Figure 1784, (used for mechanical protection with Flexible Extension or Leads) \$ .22 per ft.



## FIRE-ENDS

The accuracy and serviceability of pyrometer equipment depends very greatly on the fire-ends selected to take care of the particular applications in hand. To this end the fire-ends used with Bristol's Pyrometers have been chosen with great care, both for scientific accuracy and adaptability. The fire-ends are divided into two distinct classifications—Base Metal and Rare Metal.

### BASE METAL FIRE-ENDS

The Base Metal Fire-Ends are several in number and composed of various combinations of alloys: collectively they take care of continuous readings up to 2200°F or periodically for slightly higher temperatures. In appearance they are alike, but the difference in alloys make them adaptable for varied classes of work and temperature conditions. Several sizes of base metal fire-ends are available,  $\frac{3}{8}$  in.,  $\frac{1}{16}$  in. and .025 in. diameter wire. The standard is  $\frac{3}{8}$  in. diameter and always furnished unless otherwise specified. The smaller size is used only for low temperature work, or for intermittent use where quick readings are desired, for test purposes, etc. To distinguish the different fire-ends a curve number is assigned to each, as given below. The curve number is stamped on each fire-end terminal; likewise on the pyrometer instrument is marked the fire-end which should be used.

#### STANDARD BASE METAL FIRE-ENDS WITHOUT INSULATION



Figure 1587

#### STANDARD BASE METAL FIRE-END WITH ASBESTOS INSULATION



Figure 1588

#### STANDARD BASE METAL FIRE-END WITH BEAD INSULATION



Figure 1591

### RARE METAL FIRE-ENDS

For the higher temperatures up to 3000°F which cannot be taken care of by base metal fire-ends, a rare metal fire-end is used. The Bristol's rare metal fire-ends are standard Heraeus and made up with one element of pure Platinum, the other 90 percent Platinum and 10 percent Rhodium. These fire-ends can be furnished in two diameters, .023 inch and .0195 inch. The latter is somewhat lower in price and can be used where conditions are not too severe. Clay tube insulation is always used with the Platinum Platinum-Rhodium fire-ends, also, Bristol's standard terminal connections as shown in illustration on page 43. Curve No. 27 is applied to this type of fire-end.

#### RARE METAL FIRE-END (PLATINUM PLATINUM-RHODIUM) SHOWING CLAY INSULATION USED.

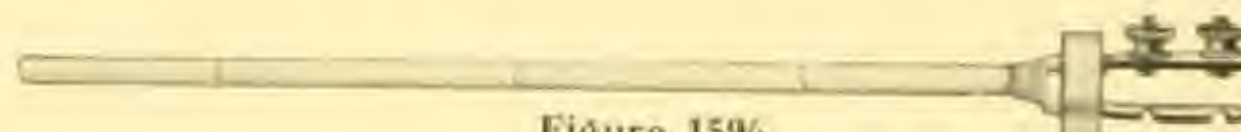


Figure 1596

#### RARE METAL FIRE-END (PLATINUM PLATINUM-RHODIUM) IN QUARTZ PROTECTION WELL



Figure 1589



## FIRE-ENDS

### FIRE-END REPLACEMENTS

As a result of the high temperatures and chemical action of gases to which fire-ends are necessarily exposed, in time they deteriorate, so that replacements are necessary. Bristol's fire-ends are not only made of properly selected materials, but are carefully tested and standardized so that it is possible to secure interchangeable fire-end replacements with ease and dispatch. With Bristol's Fire-Ends a convenient form of terminal connection is used, so that it is a simple matter to make replacements. The design of the fire-end terminal is such that they can only be joined in one way. Thus, no error due to reversal of polarity is possible. Two thumb nuts provide an absolutely rigid union and insure perfect electrical contact. This patented terminal connection is illustrated on page 43.

### STANDARD LENGTHS

Experience in specifying fire-ends for orders has proved that requirements are fairly uniform. Thus, the following lengths have been adopted as standard units: 1—1½—2—2½—3—4—5 and 6 feet. Longer lengths can be furnished to order.

STANDARD BASE METAL FIRE-END IN IRON PIPE PROTECTION WELL.  
THIS IS THE FORM OF PROTECTION MORE USED THAN ANY OTHER



Figure 1593

STANDARD BASE METAL FIRE-END IN IRON PIPE PROTECTION WELL  
WITH ADJUSTABLE FLANGE



Figure 1594

STANDARD BASE METAL FIRE-END IN IRON PIPE PRO-  
TECTION WELL BENT AT RIGHT ANGLE



Figure 1599

SURFACE CONTACT FIRE-END, BASE METAL TYPE,  
COMPLETE WITH FLEXIBLE EXTENSION LEAD  
AND WOODEN HANDLE. TO OBTAIN READ-  
INGS WITH PORTABLE INSTRUMENTS

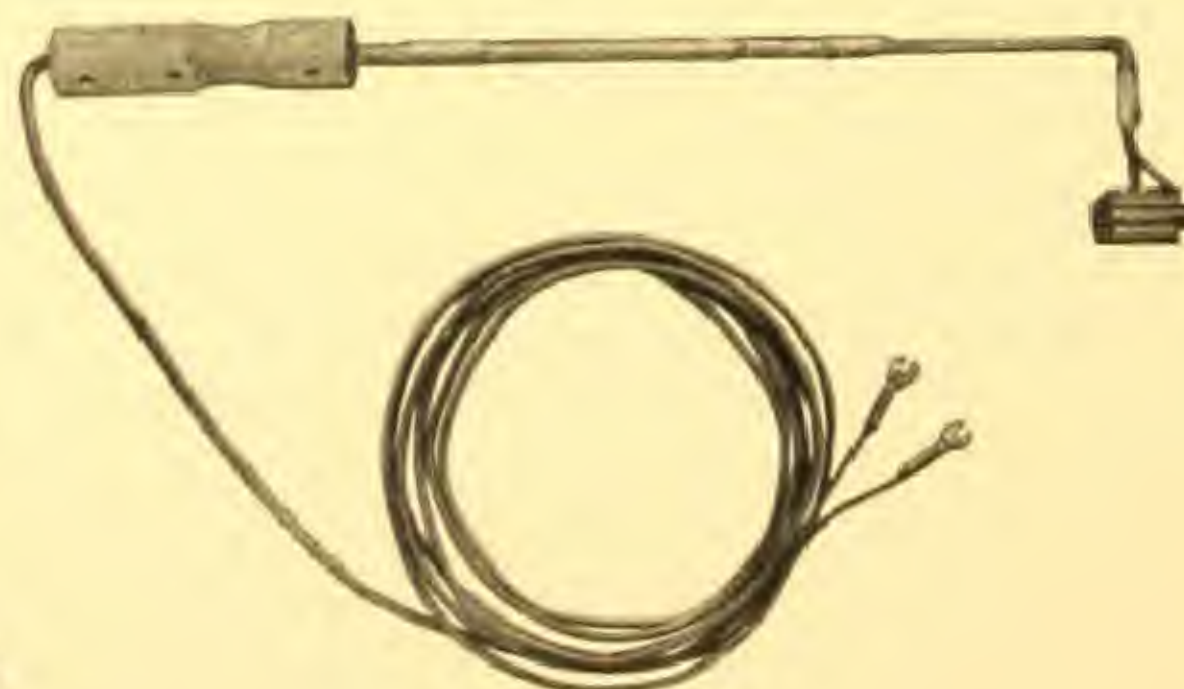


Figure 1598

BASE METAL FIRE-END IN IRON PIPE PROTECTION  
WELL WITH ADJUSTABLE FLANGE AND ELBOW



Figure 2568

ELECTRICITY

MOTION, ETC.



## FIRE-ENDS

### PENCIL TYPE FIRE-ENDS

The Pencil Type Fire-End is made with one side of  $\frac{1}{4}$ -inch iron pipe, the other side alloy wire and welded together at the tip. A fire-end made in this way is decidedly more sensitive to rapid changes in temperatures than the standard fire-end enclosed in a protection well. They are used principally with portable instruments to obtain quick intermittent readings of high temperatures, or for continuous use with low temperatures where extreme sensitivity is important.

Both illustrations of the Pencil Type Fire-End show threaded connections as used for permanent installations; however, for portable work an iron pipe extension and wooden handle are substituted, for these an additional charge of one dollar is made.

#### PENCIL TYPE FIRE-END WITH ADJUSTABLE THREADED CONNECTION



Figure 1831

#### PENCIL TYPE FIRE-END WITH RADIATING DISCS

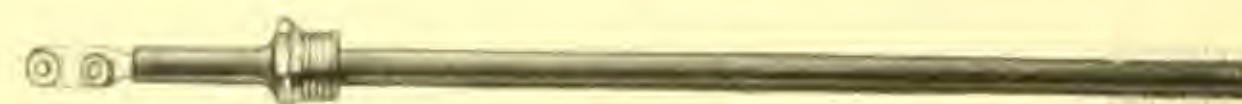


Figure 1835

The radiating discs make this even more sensitive to rapid changes in temperature than the plain pencil type fire-end.

## LIST PRICES

### BASE METAL FIRE-ENDS

Curve 18B—for continuous temperatures up to 1600°F, intermittent temperatures up to 2000°F.	
STANDARD FIRE-END, Curve 18B, 1/8-in. diameter wire, Asbestos Insulation, Length 3 feet or less.	\$3.62
STANDARD FIRE-END, Curve 18B, 1/16-in. diameter wire, Asbestos Insulation, Length 3 feet or less.	3.62
(Additional lengths) per foot.	.77
STANDARD FIRE-END, Curve 18B, 1/8-in. diameter wire, Bead Insulation, Length 3 feet or less.	5.12
(Additional lengths) per foot.	1.27
PENCIL TYPE FIRE-END, Curve 18B, with 1/4-in. diameter pipe, Length 2 feet or less.	3.05
(Additional lengths) per foot.	.83
PENCIL TYPE FIRE-END WITH RADIATING DISCS, Curve 18B, with 1/4-in. diameter pipe, 3/4-in. Threaded Connection, Length 1-foot or less.	6.00
SURFACE CONTACT COUPLE, Curve 18B, complete with 15-foot extension, Length 2-1/2 feet.	13.50
Curve 25H—for continuous temperatures up to 2200°F, intermittent temperatures up to 2500°F.	
STANDARD FIRE-END, Curve 25H, 1/8-in. diameter wire, Asbestos Insulation, Length 3-feet or less.	5.27
STANDARD FIRE-END, Curve 25H, 1/16-in. diameter wire, Asbestos Insulation, Length 3-feet or less.	5.27
(Additional lengths) per foot.	1.03
STANDARD FIRE-END, Curve 25H, 1/8-in. diameter wire, Bead Insulation, Length 3 feet or less.	6.77
(Additional lengths) per foot.	1.53
SURFACE CONTACT COUPLE, Curve 25H, complete with 15-foot Extension, Length 2-1/2 feet.	15.15
Curve 26H—for continuous temperatures up to 1500°F, intermittent temperatures up to 2500°F.	
PENCIL TYPE FIRE-END, Curve 26H, with 1/4-in. diameter pipe, Length 2-feet or less.	4.68
(Additional lengths) per foot.	1.10

### RARE METAL FIRE-ENDS (Platinum Platinum-Rhodium)

Curve 27—for continuous temperatures up to 2600°F, intermittent temperatures up to 3000°F.	
STANDARD HERAEUS COUPLE, Curve 27, one element pure Platinum, the other 90 percent Platinum and 10 percent Rhodium. Furnished in two diameters .023-inch and .0195-inch. Prices based on current market cost, will be quoted on request.	



## PROTECTION WELLS

Fire-Ends are subjected to danger of injury both mechanical and from the action of corrosive fumes. For these reasons it is essential that the proper protection be used. It is occasionally necessary to replace the protection wells, and it will be noted those shown here are so designed that they may be easily changed as required. Not all of the protections available are included here, but only those most often used.

A very practical method to select the most suitable kind of protection is to determine what materials are used in the interior construction of the furnace, crucible, etc. If it is cast iron, it would suggest cast iron protection well; if fire clay or lead, these materials should be considered. However, this does not always hold true and the characteristics mentioned in the next paragraph should be taken into account.

In selecting the correct protection for fire-end, the following points should be considered: (1) Temperature limitations. (2) Mechanical strength. (3) Size in regard to location and space available. (4) Conductivity of heat. (5) Resistance to oxidizing and reducing atmospheres. (6) Effect of gases and acids encountered. (7) Required for continuous or intermittent service?

In case you are not entirely certain in regard to the exact specifications it is best to consult with our engineers.

### WROUGHT IRON



Figure 1584

The protection more used than others for lower temperature work where extreme oxidizing atmospheres are not present, and where a better protection is not warranted because of higher cost. Used for maximum intermittent temperatures up to 1600°F, and continuous temperatures of 1500°F. Can be furnished in lengths up to 12 feet. Four sizes, 17/37" x 3/8"—11/16" x 1/2"—1-1/16" x 13/16"—1-5/16" x 1".

#### LIST PRICES

Lengths	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.
17/37" O. D. x 3/8" I. D.	\$.65	\$.75	\$.85	\$.95	\$1.05
11/16" O. D. x 1/2" I. D.	.65	.75	.85	.95	1.05
1-1/16" O. D. x 13/16" I. D.	.80	.90	1.00	1.10	1.20
1-5/16" O. D. x 1" I. D.	.80	.90	1.00	1.10	1.20

### WROUGHT IRON PIPE WITH 90° SPLIT ELBOW

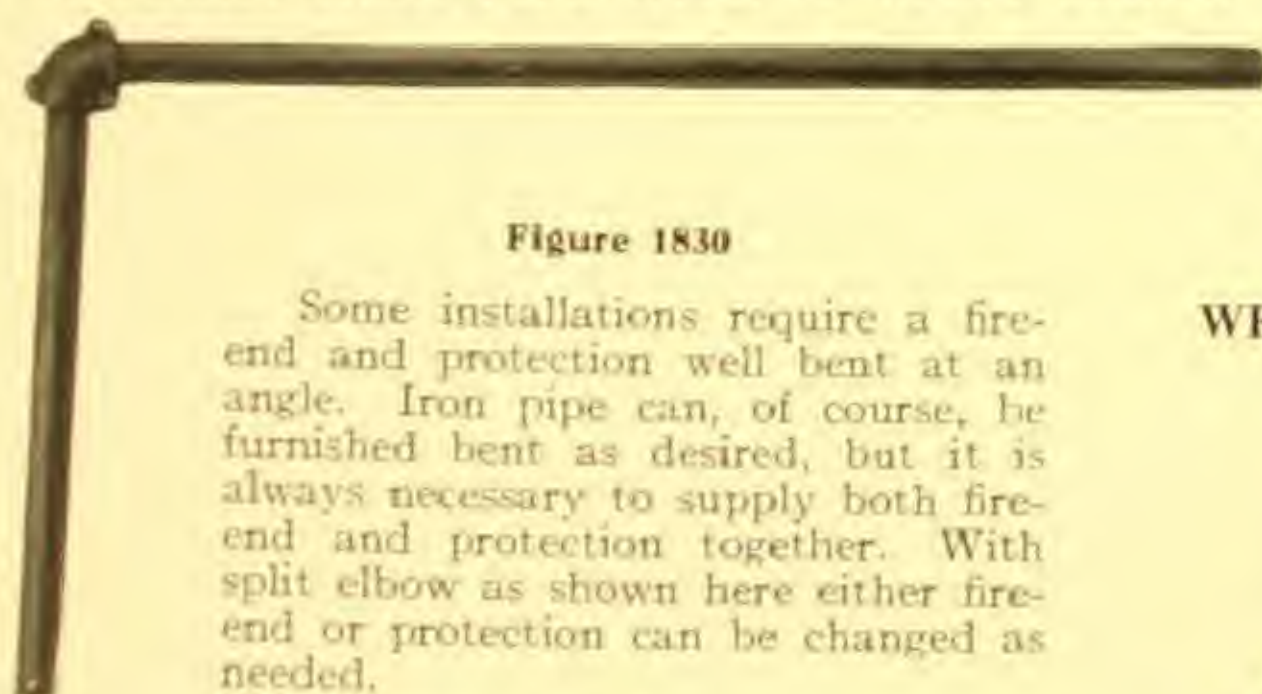


Figure 1830

Some installations require a fire-end and protection well bent at an angle. Iron pipe can, of course, be furnished bent as desired, but it is always necessary to supply both fire-end and protection together. With split elbow as shown here either fire-end or protection can be changed as needed.

#### LIST PRICE

90° Angle Split Elbow for 1/2-inch pipe	\$2.00
90° " " " " " " " "	5.00

### WROUGHT IRON PIPE WITH 45° SPLIT ELBOW



Figure 1829

#### LIST PRICE

45° Angle Split Elbow for 1/2-inch pipe \$2.00

### DOUBLE WROUGHT IRON WITH THREADED CONNECTION



Figure 1827

For extra heavy and strong protection, double wrought iron pipe is sometimes used. This consists of inside pipe 1/2 inch diameter and outside pipe 1 inch diameter. Especially adapted for wall or shell of furnace or oven. The threaded connection provides convenient means for renewals.

#### LIST PRICE

Lengths 3 feet or less.....\$7.85

HUMIDITY

ELECTRICITY

MOTION, ETC.



## PROTECTION WELLS

### CAST IRON



Figure 1882

For both primary and secondary protection where mechanical strength is an essential property, except where chemicals are present that attack cast iron. For maximum intermittent temperatures up to 2000°F, and continuous temperatures of 1600°F. Furnished in lengths up to 2 feet. Inside diameter  $\frac{5}{8}$  inch, outside diameter  $\frac{3}{4}$  inch.

#### LIST PRICES

Lengths	1 ft.	2 ft.
	\$10.00	\$15.00

### CALORIZED STEEL



Figure 1585

Gives longer service than ordinary wrought iron or steel in oxidizing or reducing atmospheres. Used for maximum intermittent temperatures up to 1700°F, and for continuous temperatures of 1550°F. Furnished in sizes and lengths given below.

#### LIST PRICES

Lengths	1 ft.	1½ ft.	2 ft.	2½ ft.	3 ft.	4 ft.	5 ft.	6 ft.
$\frac{1}{2}$ -in. O.D. x $\frac{5}{8}$ -in. I.D.	\$1.50	\$2.00	\$2.50	\$3.00	\$3.50	\$4.50	\$5.50	\$6.50
$1\frac{1}{8}$ -in. O.D. x $\frac{5}{8}$ -in. I.D.	1.75	2.25	2.75	3.25	3.75	4.75		
$1\frac{1}{8}$ -in. O.D. x 1-in. I.D.	2.25	3.00	3.75	4.50	5.25	6.00		

### NICHROME



Figure 1600

Stronger than steel and wrought iron for higher temperatures, and will give longer service for lower temperatures. Used for maximum intermittent temperatures up to 2300°F, and continuous temperatures of 2100°F. The maximum length for one piece is 4 feet. Furnished in sizes and lengths given below.

#### LIST PRICES

Lengths	1 ft.	1½ ft.	2 ft.	2½ ft.	3 ft.	4 ft.
1-in. O.D. x $\frac{5}{8}$ -in. I.D.	\$4.50	\$7.00	\$9.50	\$12.00	\$14.50	\$40.00
$1\frac{1}{8}$ -in. O.D. x $\frac{5}{8}$ -in. I.D.	4.50	7.00	9.50	12.00	14.50	40.00

### NICHROME WELDED TO IRON PIPE



Figure 1586

#### LIST PRICES

Any length Nichrome can be welded to wrought iron pipe of any required length up to 3-feet, at an extra charge of \$1.50 to prices given for Nichrome alone.

### NICKEL



Figure 1597

Well adapted as a primary protection for base metal couples and a secondary for platinum couples. A resistant to most commercial acids. Used for maximum intermittent temperatures up to 2400°F, and continuous temperatures of 2200°F. Furnished in lengths up to 5 feet. Inside diameter  $\frac{9}{16}$  inch and outside diameter  $\frac{11}{16}$  inch.

#### LIST PRICES

Lengths	1 ft.	2 ft.	3 ft.	4 ft.	5 ft.
	\$1.75	\$3.00	\$4.25	\$5.50	\$6.75



## PROTECTION WELLS

### CHROME IRON



Figure 2558

Developed specially for use with babbitt metal. Size  $1\frac{1}{4}$ " x 14" long, with  $\frac{3}{4}$ " internal thread.

#### LIST PRICES

Lengths	1 ft.	2 ft.	3 ft.
	\$4.00	\$8.00	\$12.00

### SPECIAL ALLOY WITH STEEL PIPE EXTENSION

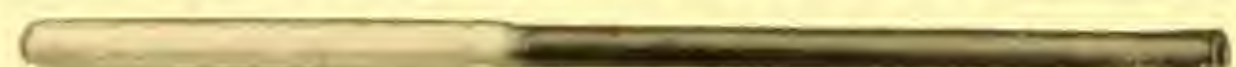


Figure 1581

This special alloy protection is used only for taking temperatures of molten brass. The standard overall length is 4 feet and although not illustrated is furnished complete with wooden handle at the end. Two sizes are available, inside diameter  $\frac{3}{8}$  inch, outside diameter  $\frac{7}{8}$  inch, for use with base metal fire-ends having asbestos insulation; inside diameter  $\frac{3}{4}$  inch, outside diameter  $1\frac{1}{8}$  inches, for use with bead insulation.

#### LIST PRICES

Lengths	Special Alloy	10-inch	Steel Pipe	38-inch	Inside Dia.	$\frac{1}{2}$ -inch	
	"	10	"	38	"	$\frac{3}{8}$	\$6.00
	"	18	"	30	"	$\frac{3}{4}$	7.25
	"		"		"		8.00

### GLASS COATED STEEL



Figure 2557

Used in connection with acids, spelters, also galvanizing tanks for operating temperatures of about 1100°F. Size  $1\frac{1}{4}$ " O. D. x  $\frac{3}{4}$ " I. D. x 18" long, having  $\frac{1}{2}$ " internal thread at open end.

LIST PRICE \$18.00

### HARDITE



Figure 2556

This is a nickel chromium alloy with low iron content. Used for intermittent maximum temperatures of 2300°F, or a continuous temperature of 2150°F. Furnished in lengths from 12 inches to 60 inches, in steps of 6 inches.

#### LIST PRICES

Lengths	1 ft.	1½ ft.	2 ft.	2½ ft.	3 ft.
$1\frac{1}{4}$ -in. O.D. x $\frac{3}{4}$ -in. I.D.	\$9.75	\$11.00	\$15.75	\$21.00	\$23.00

Any length can be welded to wrought iron pipe of any required length up to 3 feet at an extra charge of \$1.50 to above prices.

### CARBOFRAX



Figure 1879

Is a highly refractory material and makes a good secondary protection even under severe temperature conditions. For maximum intermittent temperatures up to 3000°F, and continuous temperatures up to 2800°F. Furnished in lengths up to 3 feet. Inside diameter 1 inch, outside diameter  $1\frac{1}{4}$  inches.

#### LIST PRICES

Lengths	1 ft.	1½ ft.	2 ft.	3 ft.
	\$5.00	\$6.75	\$7.25	\$14.25

### FIRE CLAY

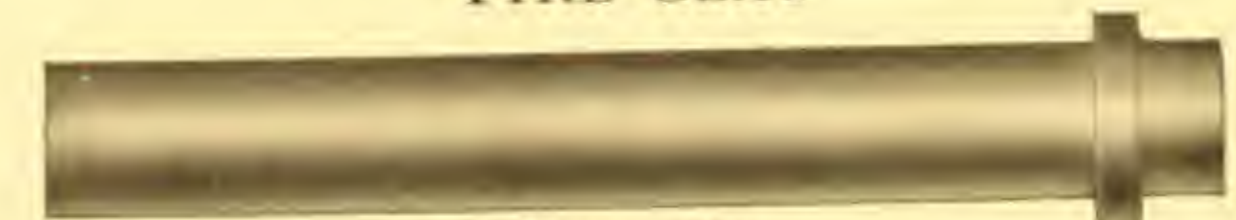


Figure 2554

Used as a secondary protection to break up the hot gases in high temperature furnaces, especially Ceramic Kilns, etc. For maximum intermittent temperatures up to 3000°F, and continuous temperatures of 2800°F. Furnished in lengths up to 3 feet. Inside diameter  $1\frac{1}{4}$  inch, outside diameter 3 inches.

#### LIST PRICES

Lengths	1 ft.	1½ ft.	2 ft.	2½ ft.	3 ft.
	\$2.00	\$2.75	\$3.50	\$4.00	\$4.75

ELECTRICITY

MOTION, ETC.



## PROTECTION WELLS

### CORUNDITE

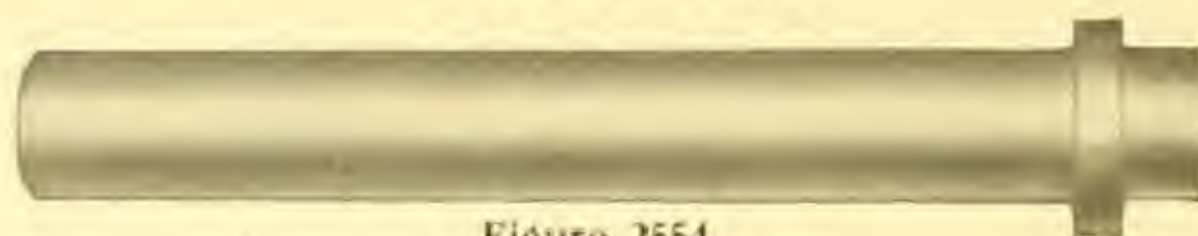


Figure 2554

Principally used as a secondary protection to porcelain and quartz. Resists most fluxing actions and can be mounted permanently in kiln or furnace. Used for maximum intermittent temperatures up to 3000°F, and continuous temperatures of 2800°F. Furnished in lengths up to 4 feet. Inside diameter  $1\frac{1}{4}$  inches, outside diameter 3 inches.

#### LIST PRICES

Lengths	1 ft.	1½ ft.	2 ft.	2½ ft.	3 ft.	4 ft.
	\$3.50	\$3.75	\$4.00	\$5.75	\$6.00	\$8.00

### GRAPHITE

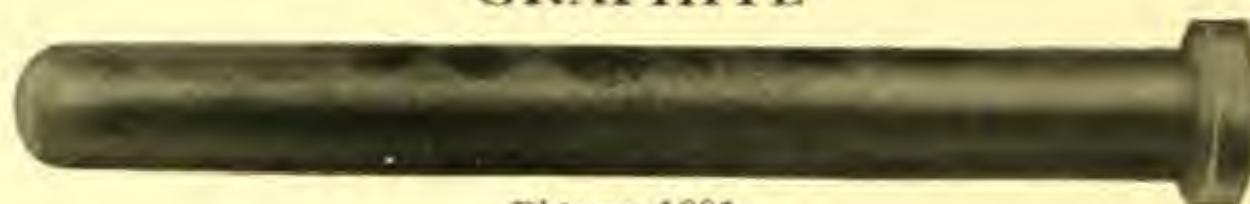


Figure 1881

For secondary protection to fire-ends made of Platinum Platinum-Rhodium. The primary protection used should be of material such as porcelain or quartz, to protect the platinum against vapors distilled from the graphite. Used for maximum intermittent temperatures up to 3000°F, and continuous temperatures of 2800°F. Furnished in lengths up to 3 feet. Inside diameter  $\frac{5}{8}$  inch, and outside diameter  $1\frac{1}{4}$  inches.

#### LIST PRICES

Lengths	1 ft.	2 ft.	3 ft.
	\$1.75	\$2.25	\$4.40

### HARD PORCELAIN

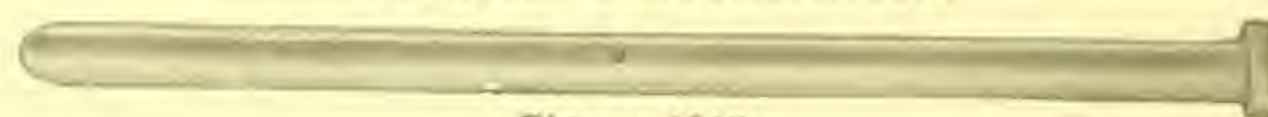


Figure 1817

Especially adapted for high temperature applications as a primary protection impervious to oxidizing atmospheres and the action of most acids and chemicals. Used for maximum intermittent temperatures up to 2900°F, and continuous temperatures of 2800°F. Furnished in lengths up to 4 feet for sizes as given below.

#### LIST PRICES

Lengths	1 ft.	1½ ft.	2 ft.	2½ ft.	3 ft.	4 ft.
$\frac{7}{8}$ -in. O.D. x $\frac{1}{2}$ -in. I.D.	\$2.75	\$4.25	\$6.00			
$\frac{1}{2}$ -in. O.D. x $\frac{1}{8}$ -in. I.D.	2.75	4.25	6.00	\$7.50	\$10.00	\$15.00
1-in. O.D. x $\frac{3}{8}$ -in. I.D.	2.75	4.25	6.00	7.50	10.00	15.00
1½-in. O.D. x 1-in. I.D.	2.75	4.25	6.00	7.50	10.00	15.00

### QUARTZ

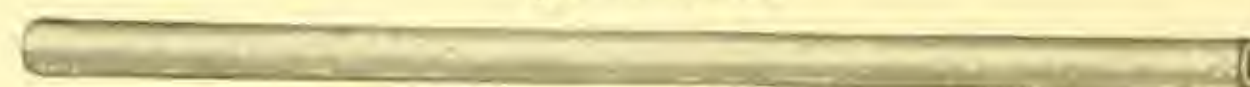


Figure 1590

For all kinds of high temperature work, especially where subjected to sudden changes. A good resistant to most acids. Well adapted as a primary protection for platinum couples. Used for maximum intermittent temperatures up to 2800°F, and continuous temperatures of 2200°F. Furnished in lengths up to 4 feet.

#### LIST PRICES

Lengths	1 ft.	2 ft.	3 ft.	4 ft.
$\frac{7}{8}$ -in. O.D. x $\frac{1}{8}$ -in. I.D.	\$4.00	\$5.25	\$5.50	
$\frac{1}{2}$ -in. O.D. x $\frac{1}{8}$ -in. I.D.	4.00	5.25	6.50	\$7.75



Figure 2555

### SILICA BLOCK

A refractory for high temperatures around 2800°F., suitable for glass or similar furnaces. Size at large end 6" x 6". Inside hole  $1\frac{1}{4}$ " diameter.

#### LIST PRICES

Lengths	14-in.	22-in.
	\$4.50	\$6.00

Figure 1881



## FIXTURES

### DIESEL ENGINE COUPLE FIXTURE



Figure 2530

Standard Diesel Engine Couple Fixture with protection well have  $\frac{3}{4}$ -inch pipe thread connection and right-angle weather-proof cap protection for terminals.

#### LIST PRICE

Standard Diesel Engine Couple Fixture  
(as illustrated) \$11.00

### QUICK DETACHABLE FIRE-END FIXTURE

This fixture is furnished where it is desired to detach fire-end frequently from the lead for taking intermittent temperatures. Especially designed for use in connection with rotary furnaces where intermittent temperatures only are taken.

#### LIST PRICE

Quick detachable Plug and Receptacle  
\$7.50

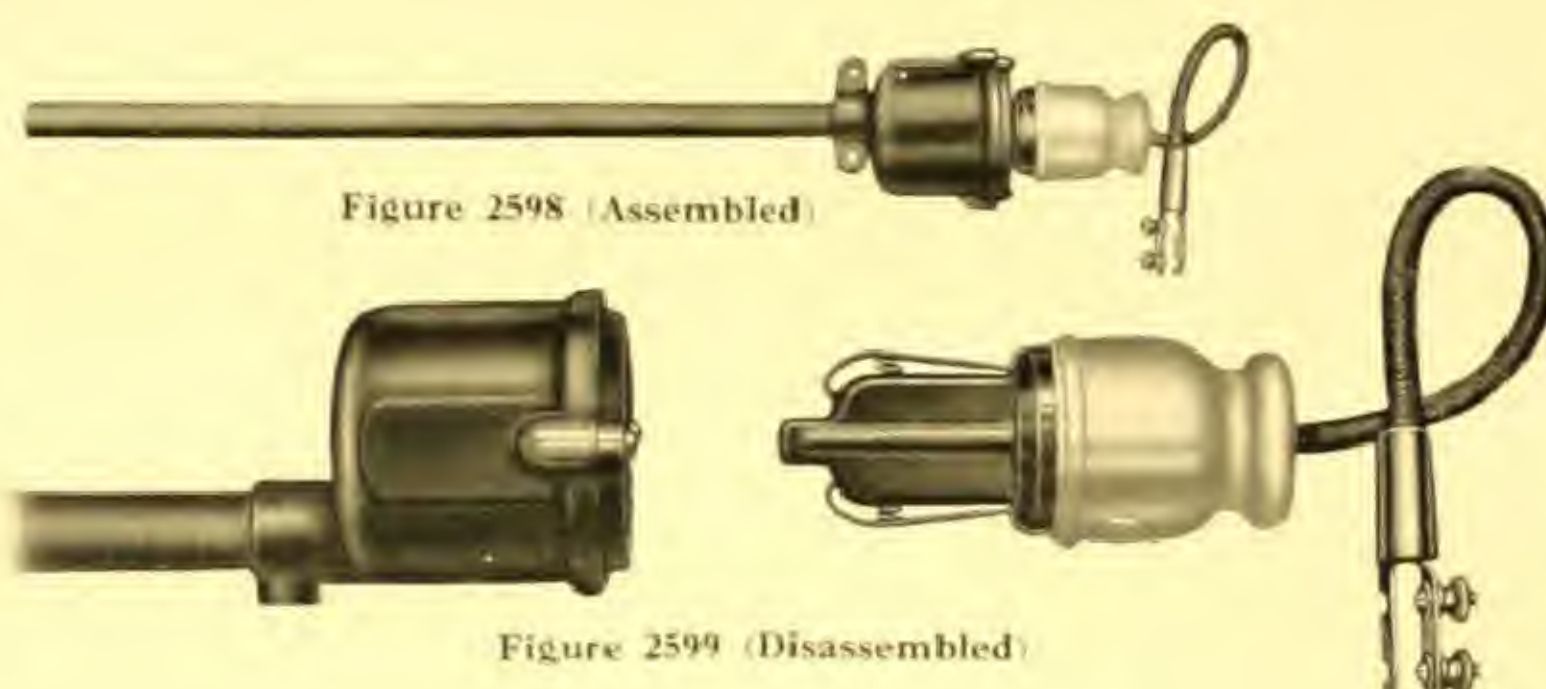


Figure 2598 (Assembled)

Figure 2599 (Disassembled)



Figure 1583

### WEATHER-PROOF FIXTURE FOR BLAST FURNACE MAIN

This is a standard fixture used on Blast Furnace Mains, consisting of a Nichrome tip protection well with threaded connections, complete with weather-proof shell for fire-end terminals.

#### LIST PRICE

Weather-Proof Fixture complete ..... \$13.20

### WATER-PROOF TERMINAL HOOD



Figure 1883

Especially designed for brick kiln installations to protect the fire-end and terminal connections from exposure to the weather. The hood illustrated is made of cast iron, but can also be furnished in aluminum.

#### LIST PRICES

Water-Proof Terminal Hood,	
Cast Iron .....	\$6.00
Aluminum .....	8.00

### WATER-PROOF TERMINAL CAP



Figure 1832

This terminal cap is used where the fire-end terminals are exposed to outside weather conditions, excessive moisture, or dirt. Recommended for use where the wiring is enclosed in conduit as it provides a complete protection and finished appearance.

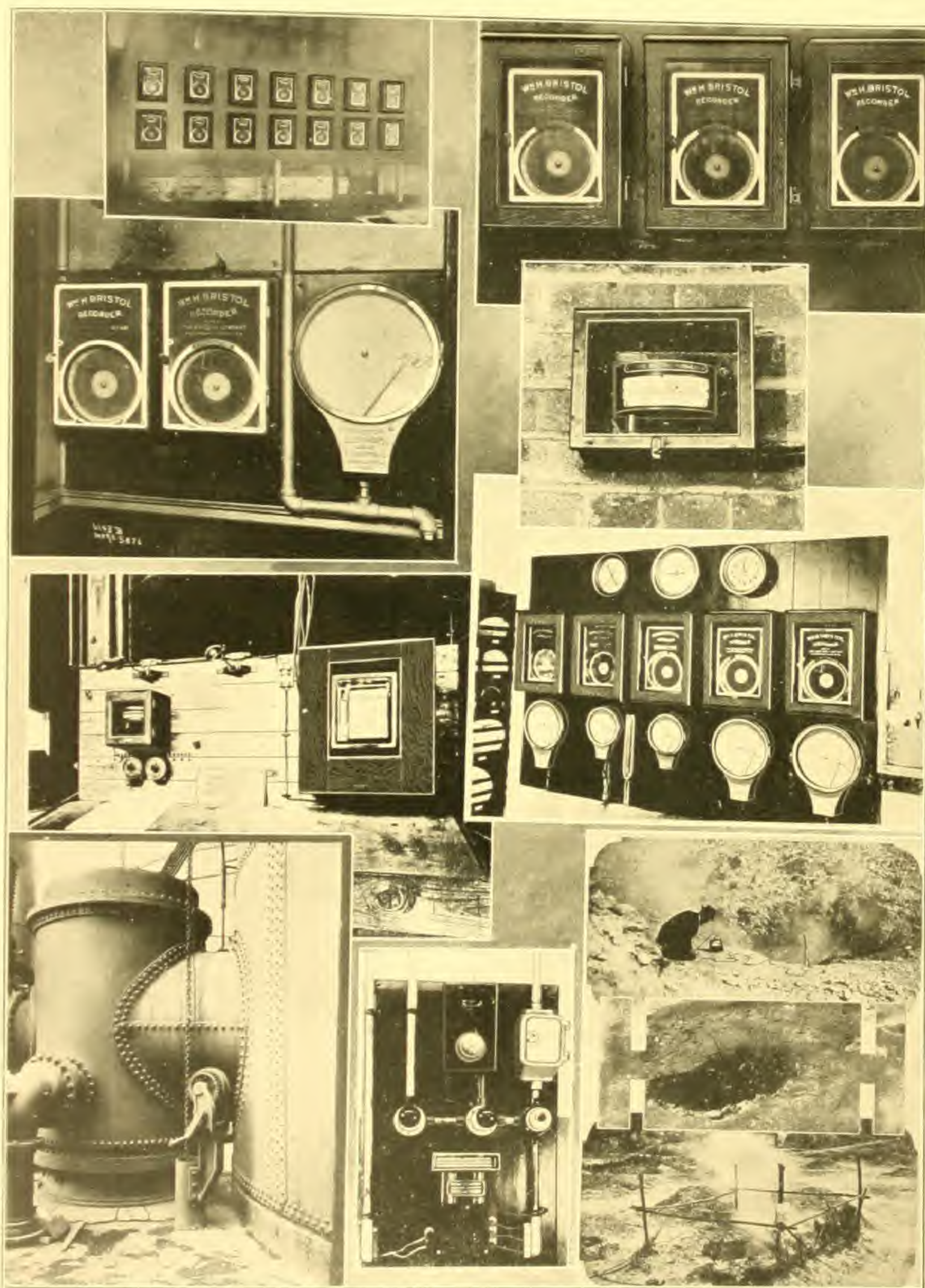
#### LIST PRICE

Water-Proof Terminal Cap ..... \$6.00





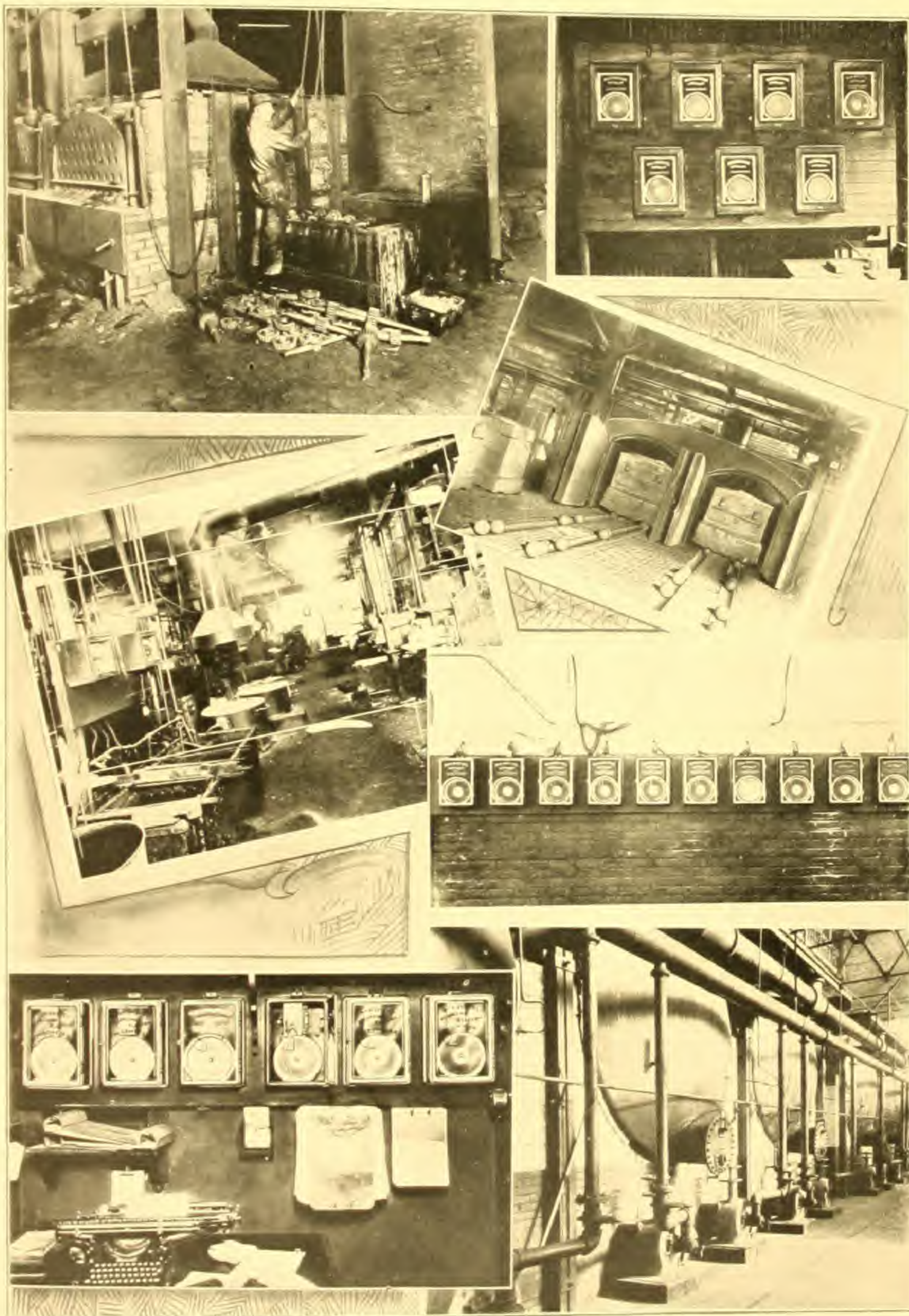












ELECTRICITY

MOTION, ETC.



## SKETCHES SHOWING APPLICATION OF FIRE-ENDS

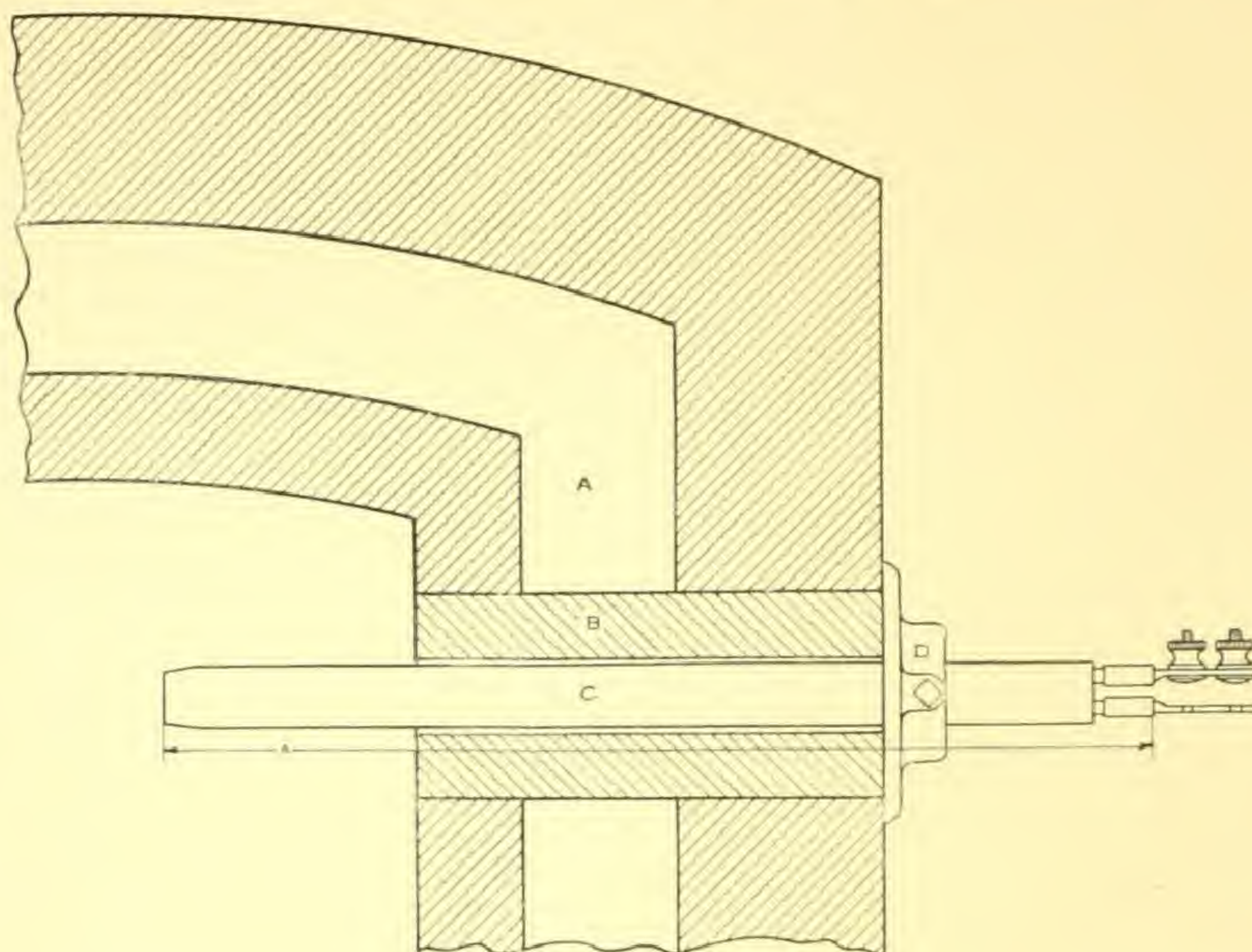


Figure 1726

Fire-ends installed in muffle furnace.

- A. Heated Gases.
- B. Brick or other heavy wall.
- C. Iron pipe well.
- D. Adjustable flange.

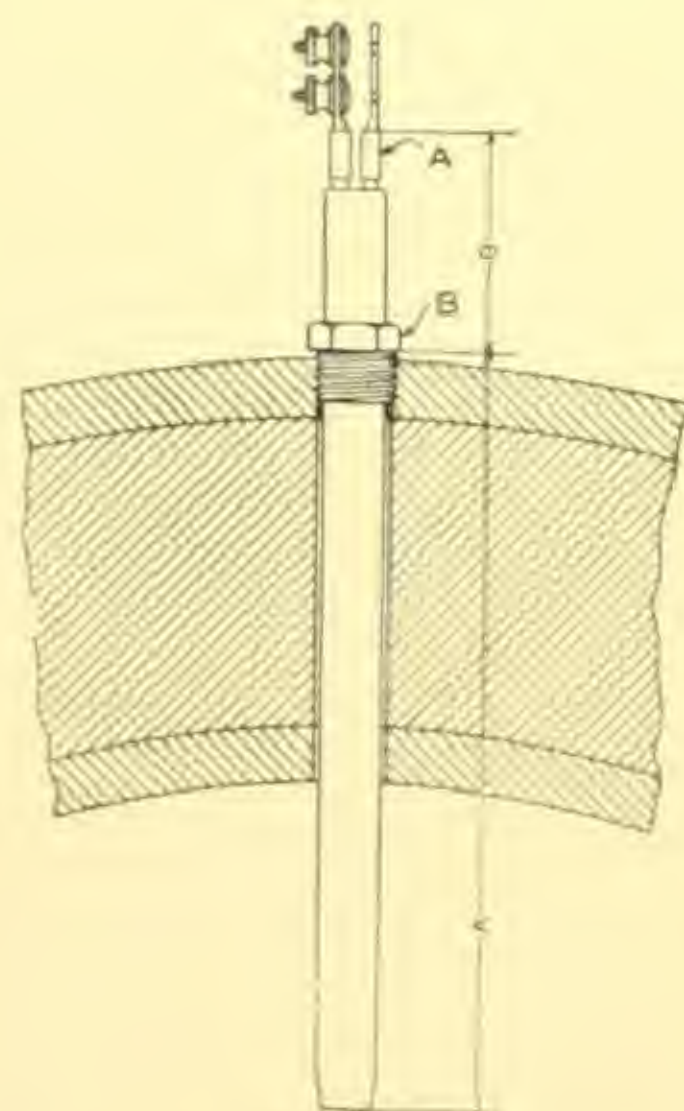


Figure 1733

Fire-end installed under pressure in furnace.

- A. Fire-end.
- B. Bushing, 3/4-inch iron pipe thread welded to iron pipe well.

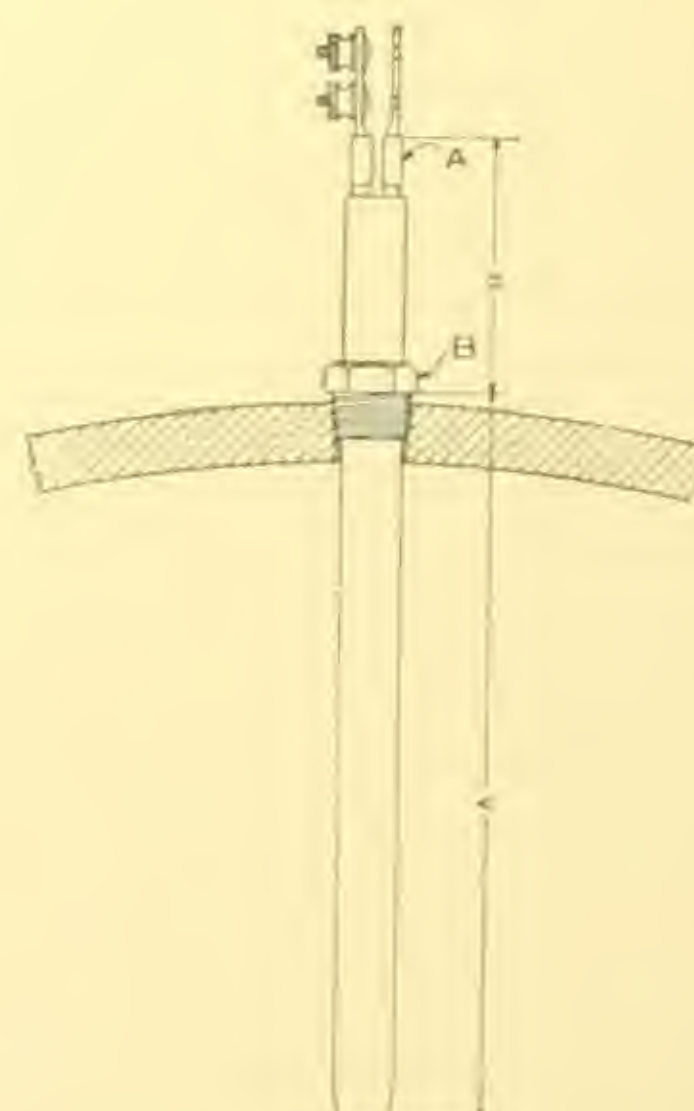


Figure 1734

Fire-end installed under pressure in thin shell of tank or furnace.

- A. Fire-end.
- B. Bushing, 3/4-inch iron pipe thread welded to iron pipe well.



# SKETCHES SHOWING APPLICATION OF FIRE-ENDS

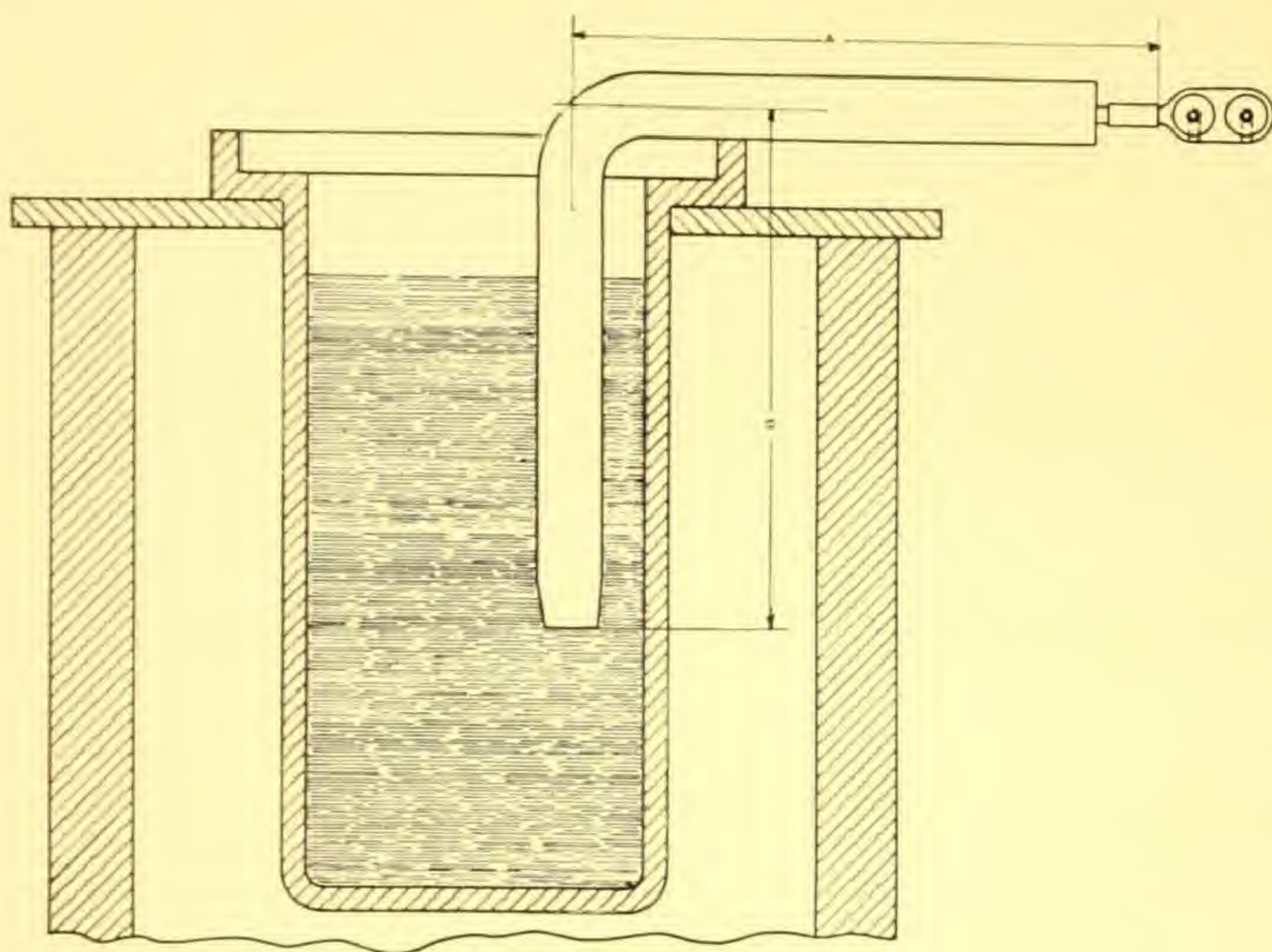


Figure 1727

Fire-end bent at right-angle, installed in metal bath.

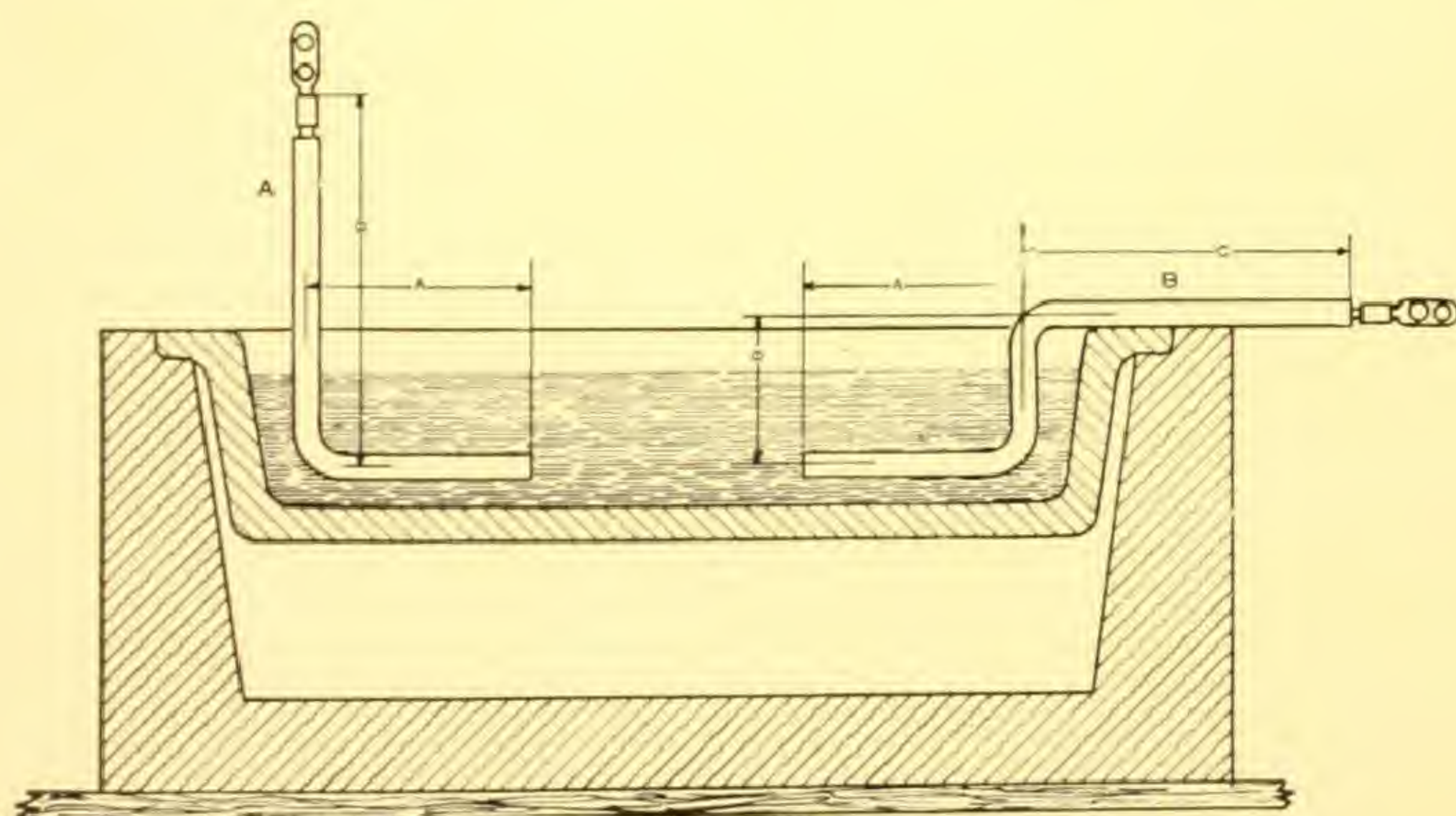


Figure 1729

Bent fire-ends installed in very shallow metal bath.

- A. Single bend.
- B. Double bend.

ELECTRICITY

MOTION, ETC.



### SKETCHES SHOWING APPLICATION OF FIRE-ENDS

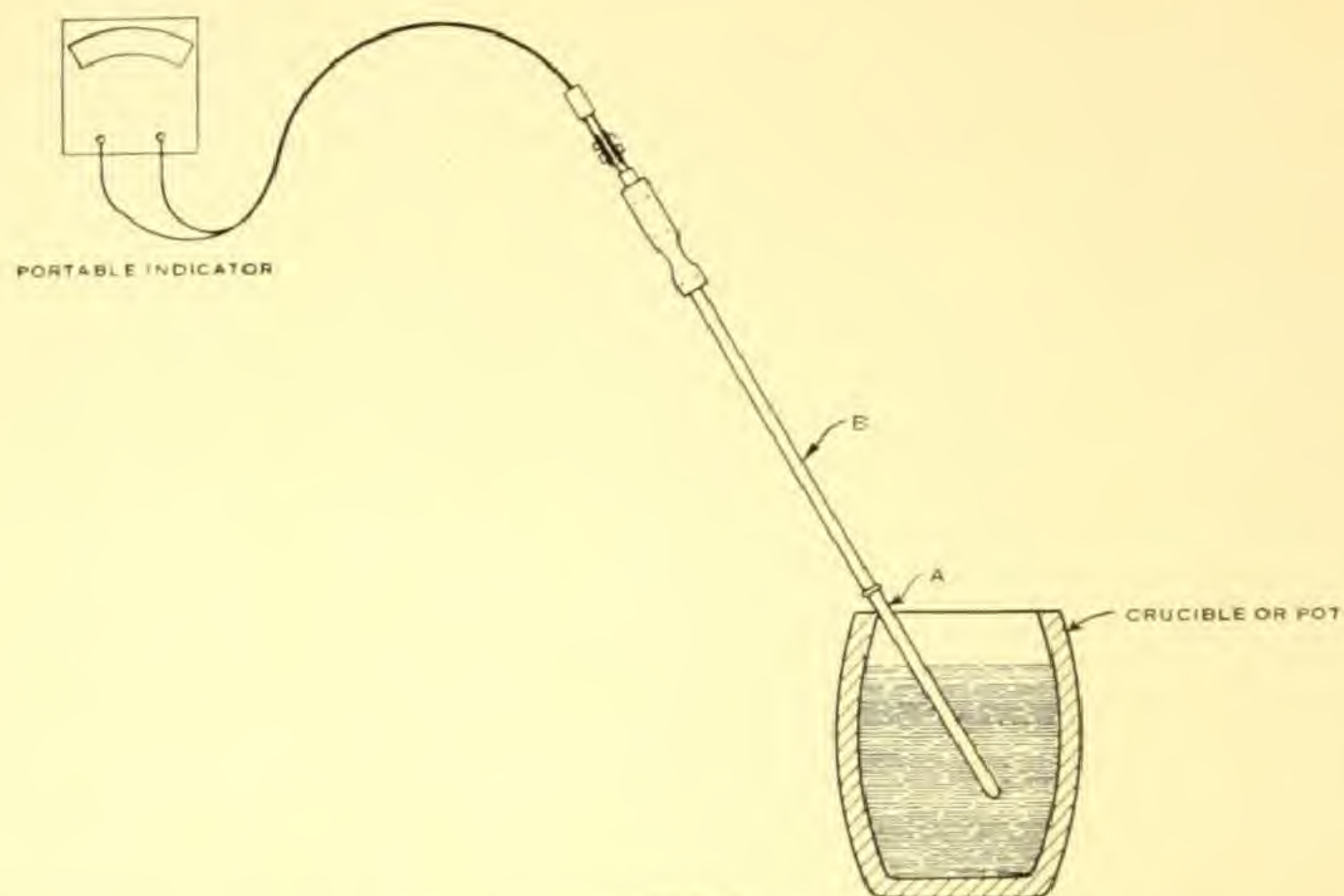


Figure 1728

Portable Indicating Pyrometer, complete with flexible extension lead and fire-end, for taking temperatures of molten metal.

- A. 10-inch Chromon tip.
- B. Iron pipe extension.

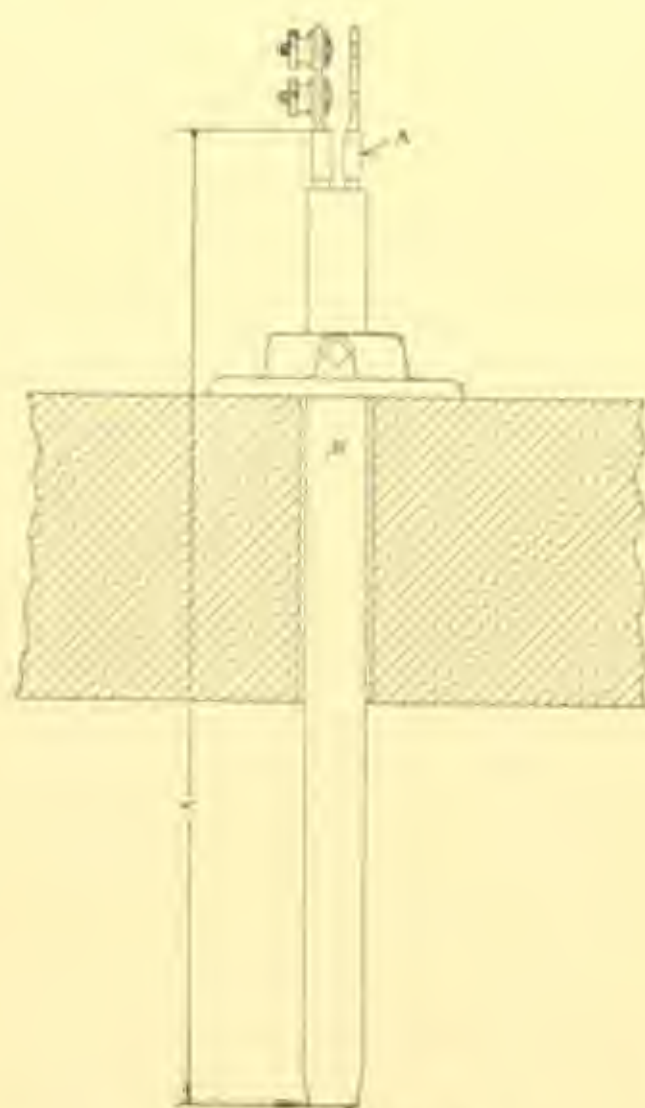


Figure 1730

Fire-end installed in top or side of furnace where there is no pressure.

- A. Fire-end.
- B. Iron pipe well.

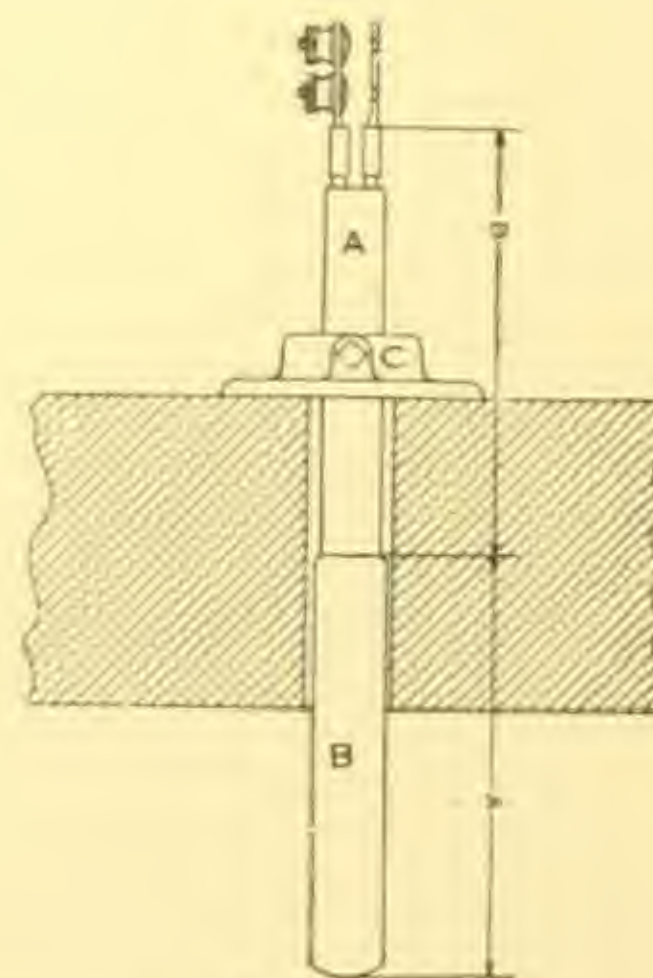


Figure 1732

Fire-end installed in top or side of furnace where there is no pressure, using protection well with Nichrome tip.

- A. 1/2-inch wrought iron pipe.
- B. Nichrome tip.
- C. Adjustable flange.



# SKETCHES SHOWING APPLICATION OF FIRE-ENDS

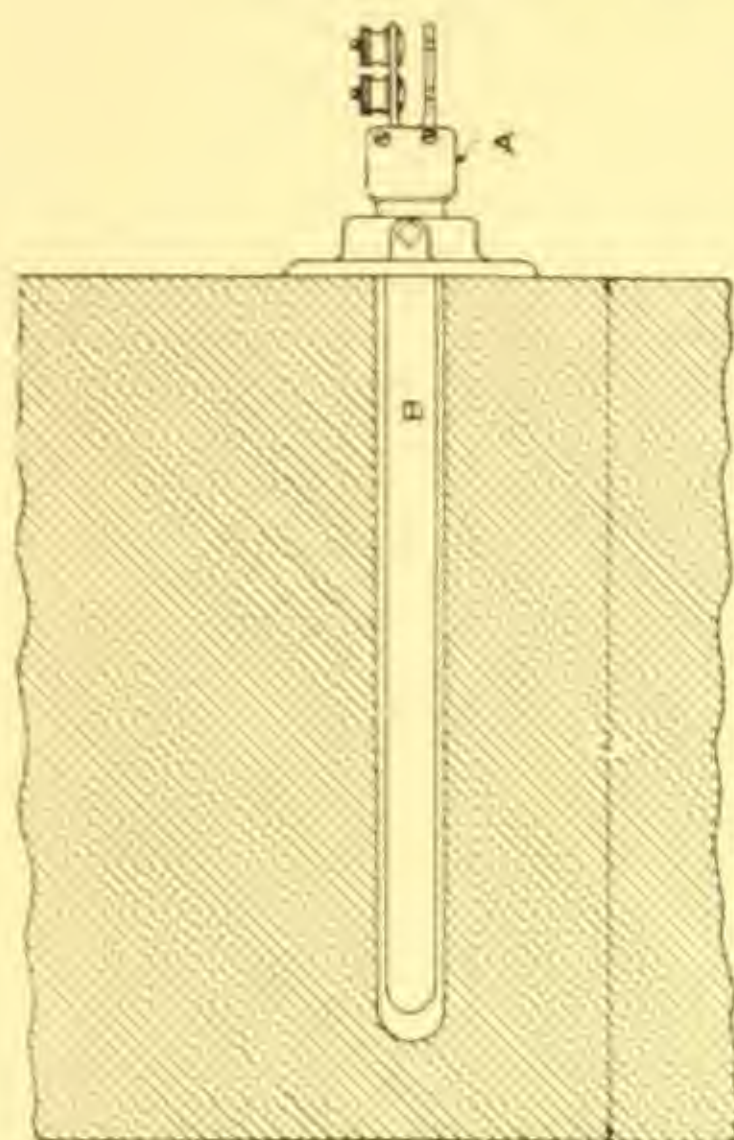


Figure 1736

Platinum fire-end installed in pocket drilled into lining of furnace.

- A. Head of Platinum couple.
- B. Quartz well.

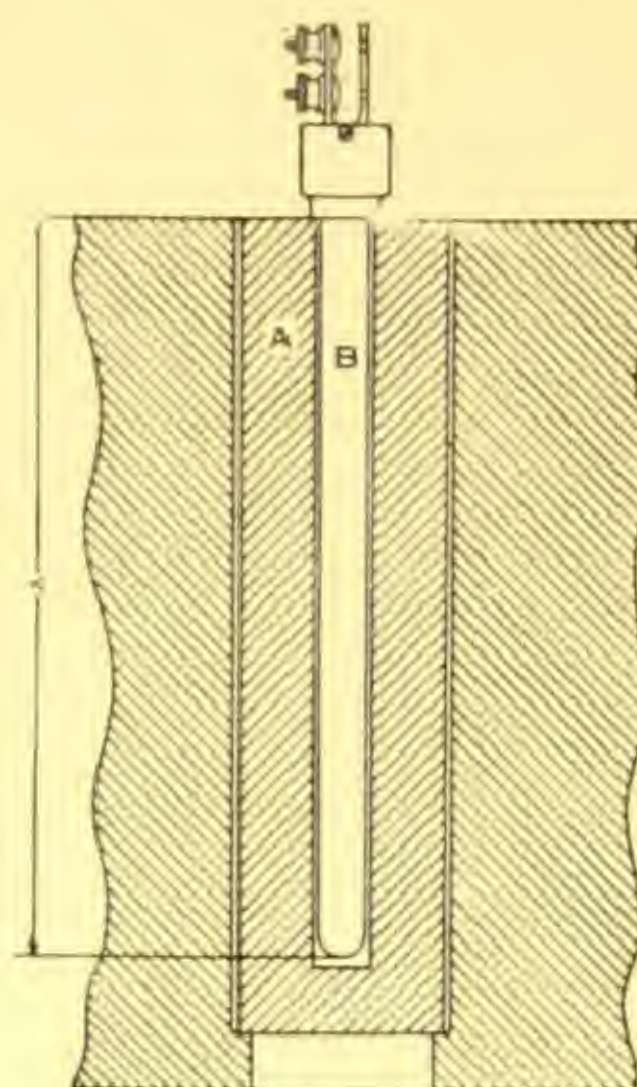


Figure 1735

Platinum couple as installed in Glass Furnace.

- A. Brick or clay well.
- B. Quartz well protecting Platinum couple.

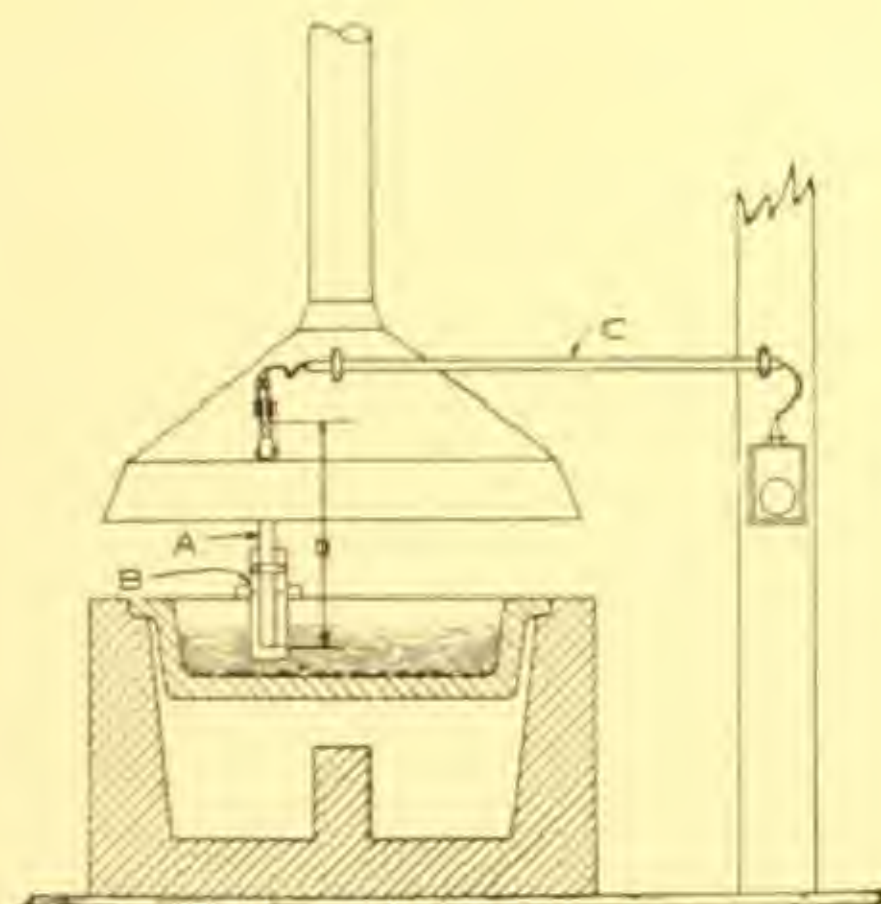


Figure 1731

Fire-end installed in Galvanizing Bath

- A. Fire-end in Calorized well.
- B. Steel strip 1-inch by 4-inches by 12-inches.
- C. 3/4-inch conduit.

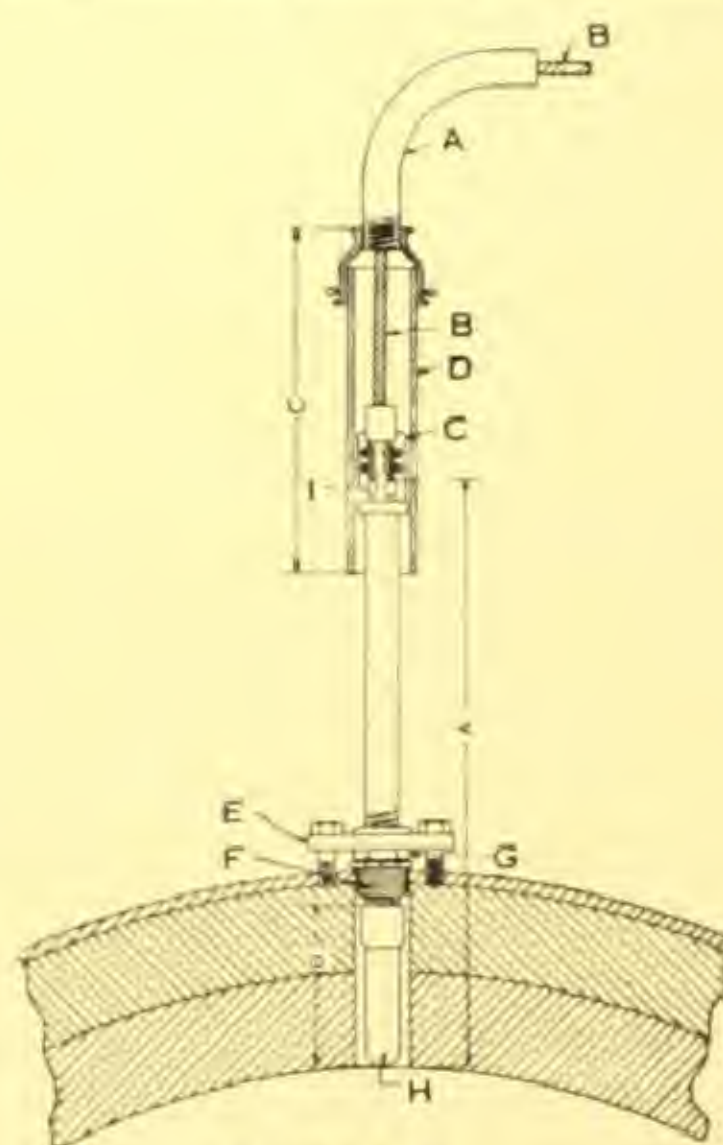


Figure 1746

Fire-end installed in Blast Furnace main.

- A. 1-inch pipe.
- B. Extension of Leads.
- C. Wooden box for terminals of fire-end.
- D. 2-inch hood.
- E. Strengthening flange.
- F. Bushing 1 1/2-inch x 3/4-inch.
- G. Lock-nut.
- H. Special alloy well.
  - a. 36-inches.
  - b. 8 3/4-inches.
  - c. 19-inches.

INDUSTRY

FOR DRILLING, TAPPING, GRINDING, TURNING, BENDING, POLISHING, MACHINING, AND ALL OTHERS, SEE THE BRISTOL COMPANY, WATERBURY, CONN., U. S. A.

ELECTRICITY

MOTION, ETC.



## WIRING DIAGRAMS

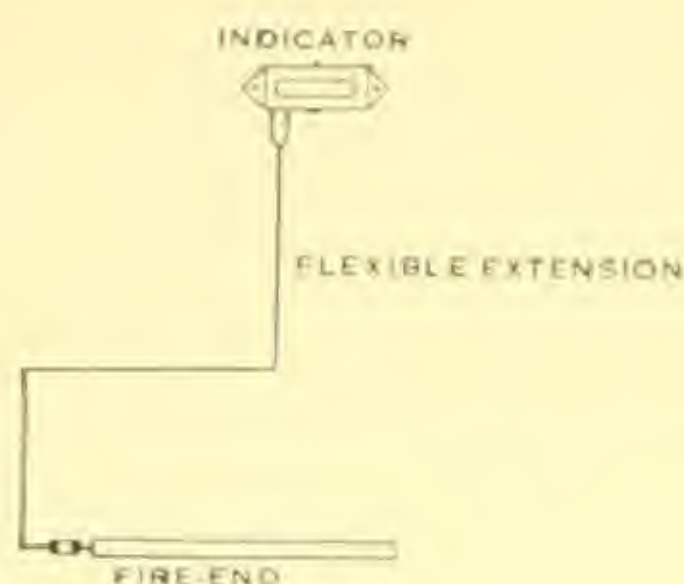


Figure 1740

Indicating Pyrometer with lead and fire-end

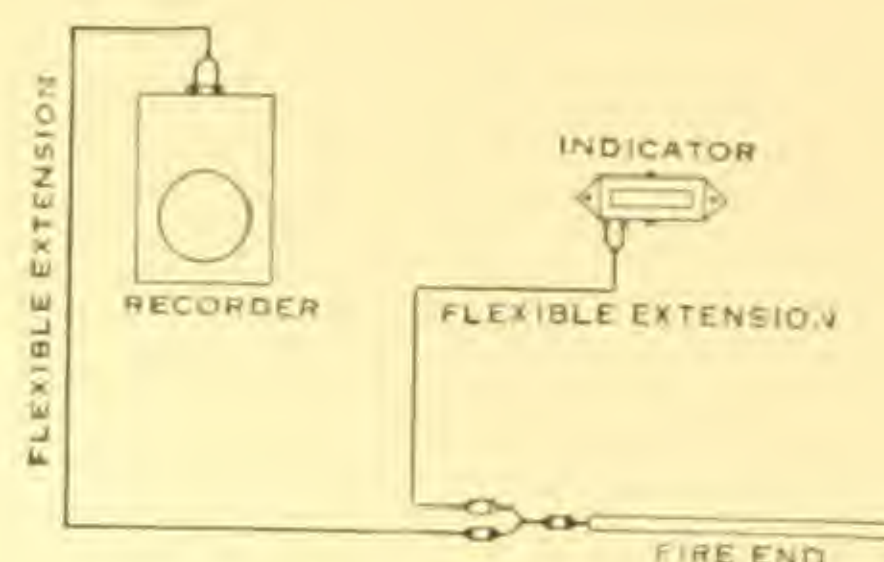


Figure 1738

One Indicating Pyrometer and one Recording Pyrometer both connected direct to one fire-end.

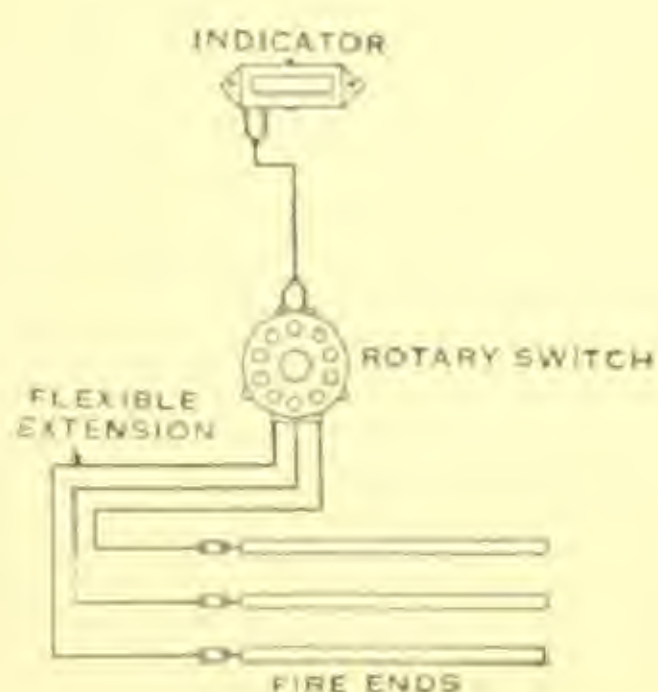


Figure 1739

Indicating Pyrometer with Rotary Switch which may be arranged for connecting from 2 up to 20 different fire-ends.

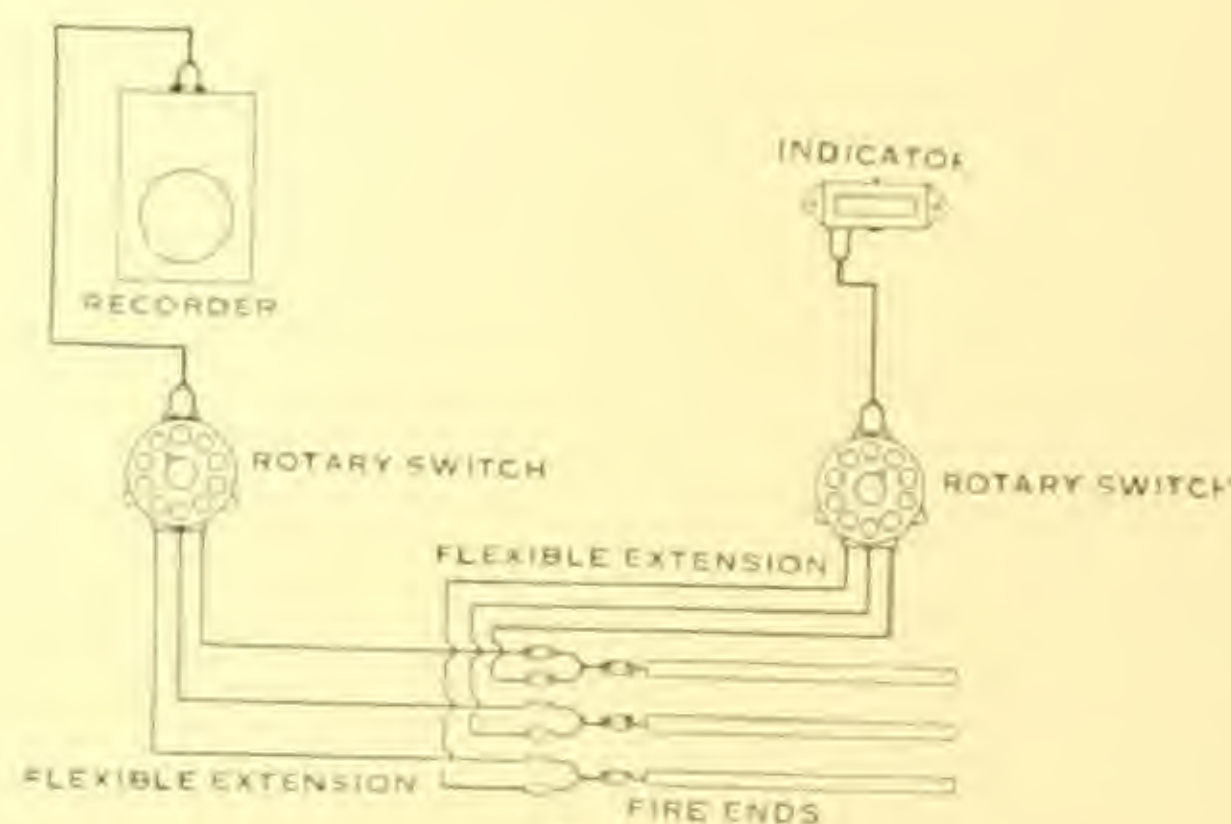


Figure 1741

One Recording Pyrometer and one Indicating Pyrometer each with Rotary Switch, and both instruments connected direct to the same fire-ends.

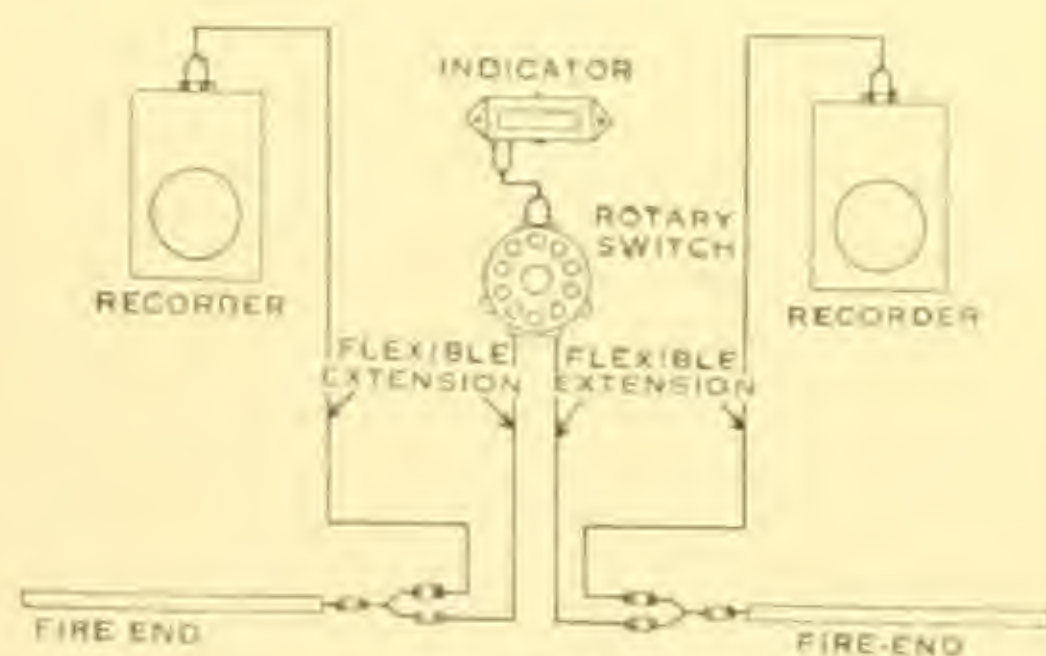


Figure 1742

Several Recording Instruments with fire-ends. One Indicating Pyrometer with Rotary Switch.

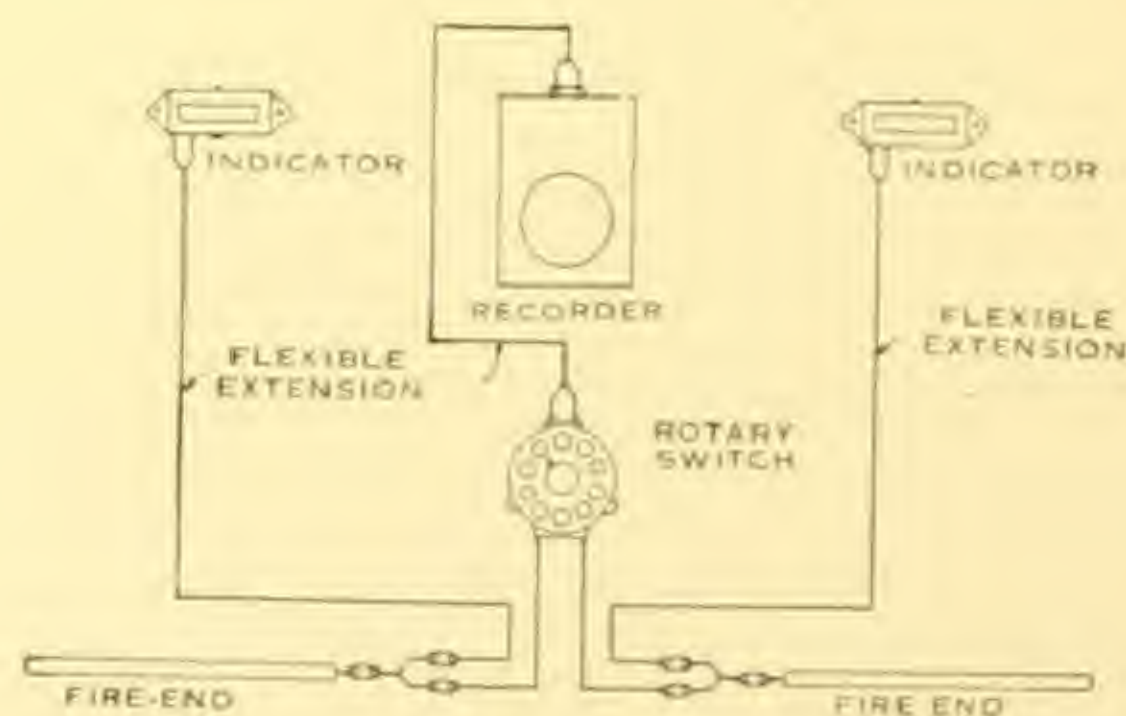


Figure 1737

Recorder with Rotary Switch and several Indicating Instruments.



## DETAILS FOR ORDERING BRISTOL'S PYROMETERS

(This information will help to secure most suitable equipment for your particular requirements.)

1. INDICATING OR RECORDING.
2. MODEL NUMBER.
3. FINISH OF CASE. (If other than standard.)
4. CONNECTIONS. (Front or back connection.)
  - (a) Indicating Pyrometer for mounting on wall or switchboard are standard with front-connection.
  - (b) Round Chart Recording Pyrometer Model 437 is standard with top-connection for mounting on wall or switchboard. Can also be furnished top-back connection for switchboard use.
  - (c) Strip Chart Recording Pyrometer Model 425 Single Record and Double-Movement Double-Record are standard with side-connection for mounting on wall or switchboard; Multiple Record Model 425 has binding posts on top.
5. RANGE.
 

Maximum and minimum temperatures also average working temperatures which will be required to measure. Specify whether it is desired to read in degrees of Fahrenheit or Centigrade.
6. SCALE NUMBER. (For Indicating Pyrometer.)
 

Specify by number if listed. The scales most frequently used are listed in this catalogue. If these do not fully meet your requirements, be sure to give details as per item Number 5, and any further data possible.
7. CHART NUMBER. (For Recording Pyrometer.)
 

Give chart number if listed. The charts most often used are listed in this catalogue. If they do not fully meet your requirements, be sure to give details as per items Nos. 5 and 8, also any further data possible.
8. CLOCK OR REVOLUTION OF CHART.
 

ROUND CHART—24 hour is standard.  
10 second vibrator standard for 24 hours.

STRIP CHART —Clock speed 1-inch per hour standard.  
1-minute vibrator on Single Record, and Double-Movement Double Record Instruments. 13-second vibrator on Multiple Record Instrument.
9. WORKING CONDITIONS.
 

INSTRUMENT	<ol style="list-style-type: none"> <li>1. What are the temperature conditions surrounding the instrument, constant or fluctuating, if constant about what degree Fahrenheit?</li> <li>2. Will the instrument be installed where it is subjected to excessive dust, dirt, dampness or chemical fumes?</li> <li>3. Is wooden protection case required?</li> </ol>
LEAD	<ol style="list-style-type: none"> <li>1. Length of Flexible Extension or Lead if other than standard.</li> <li>2. Approximate temperatures along the Lead?</li> <li>3. Will it be subjected to excessive dampness or chemical fumes?</li> <li>4. Are they to be installed in conduit, if not, how installed?</li> </ol>
FIRE-END	<ol style="list-style-type: none"> <li>1. Length of Fire-End.</li> <li>2. Fire-End straight or bent, what angle and how far from tip?</li> <li>3. Where are the Fire-Ends to be installed?</li> <li>4. For what class of work are they required, Dry Heat, Molten Metal, Liquids?</li> <li>5. Are they subjected to rough handling?</li> <li>6. Will they encounter injurious gases or chemical fumes?</li> </ol>
10. MULTIPLE CONNECTIONS.
 

If more than one fire-end is used with an instrument, specify how many points of connection are required, and length of each.
11. COMBINATION OF INSTRUMENTS.
 

If more than one instrument is used in combination, give information requested above and refer to wiring diagrams on page 60, or submit sketch of your own recommendations.

ELECTRICITY

MOTION, ETC.



## ADDITIONAL SUPPLIES

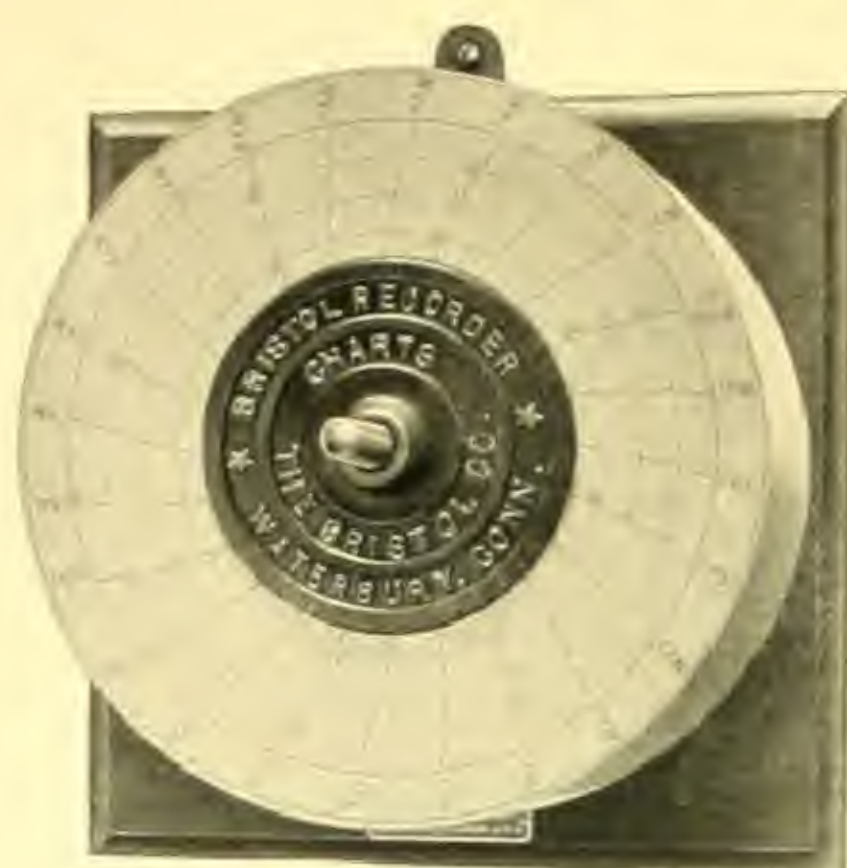


Figure 478



Figure 2236

### CHARTS

Every Recording Pyrometer is calibrated to be used with the particular chart specified. This fact makes it necessary that every chart must be identical without the slightest variation in order to insure accuracy. For this reason, every attention is given to the finest details which make Bristol's charts absolutely accurate and reliable under all conditions.

Even the paper on which Bristol's Charts are printed is made specially for the purpose. The charts are printed in our own plant from extremely accurate engravings and under uniform humidity conditions.

The accuracy of Bristol's Recording Pyrometers cannot be guaranteed unless genuine Bristol's Charts are used. To identify them, every round chart is printed on paper having water mark reading "Bristol's" and the name of The Bristol Company printed in the center. All strip charts have "The Bristol Company" printed on the side.

Bristol's Round Charts are sold by the hundred. When placing orders specify by the hundred or multiple thereof. Strip Charts are sold by the roll 90 feet in length. With each new Round Chart Type Recorder are included 100 Charts and 1 quart of Fixative. With new Strip Chart Recorder is included one 90-foot chart roll.

#### LIST PRICES

Bristol's 8-Inch Smoked Charts, per 100.....	\$2.75
Bristol's Strip Chart per roll 90-Ft. long.....	1.50

### FIXATIVE FOR SMOKED CHARTS

#### LIST PRICES

Fixative Solution for Smoked Charts, per qt. can.....	\$ .80
Special Glass Jar for fixing 8-Inch Smoked Charts.....	.30

### RIBBONS FOR STRIP CHARTS

#### LIST PRICES

Single Color Ribbon for use with Strip Chart Pyrometer—if not otherwise specified, purple color will be furnished, each.....	\$ .45
Two-Color Ribbon for use with Multiple Record Strip Chart Pyrometer, each.....	1.25
Three-Color Ribbon for use with Multiple Record Strip Chart Pyrometer, each.....	1.25
Six-Color Ribbon for use with Multiple Record Strip Chart Pyrometer, each.....	1.25

### CHART HOLDER

#### LIST PRICE

Chart Holder for 8-Inch Round Chart, each.....	\$2.20
(In ordering be sure to specify whether for wall or shelf use.)	

All Prices on this page are F. O. B. Waterbury, Conn.



## AUTOMATIC TEMPERATURE CONTROL

### BRISTOL'S PYROMETER CONTROLLER MODEL 479

Automatic control of temperature is the ideal sought for in heat treating processes, especially when quantity production is involved and duplication is necessary. The result in an economy of fuel, less help required, and the elimination of spoiled work, are factors which cannot be overlooked in considering the possible use of automatic temperature regulation.

On heat treating apparatus using oil, gas, or electricity, Bristol's Pyrometer Controller Model 479 is used to accomplish automatic control for temperatures between 800° and 3000° F.



Figure 2481

The instrument is a high resistance pyrometer operating on the thermo-electric principle. It functions as a thermostat and is equipped with adjustable contactor which can be set at any point on the scale it is desired to hold the temperature. The fire-end (or thermo-couple), is installed in the furnace, oven, or other apparatus of which it is required to control the temperature. As the temperature of the fire-end rises or falls, the indicating arm of the instrument makes or breaks an electrical contact. This automatically opens or closes electrically operated valves or relays, thus decreasing or increasing the supply of heating medium, which results in holding the temperature at a very close degree.

Model 479 is superior to any previous equipment offered. It incorporates features which make it most desirable, including:

1. Dust-Tight Case.
2. 7-Inch Scale. The longest used at the present time in any thermo-electric controller.
3. Very close regulation possible. In fact, so close that a movement of the pointer not visible to the naked eye determines the change in temperature.

To use with the automatic controller, suitable valves, either solenoid or motor operated can be supplied for oil or gas. Also necessary relays and switches for electrical control. Details and prices submitted at request.

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
 REG. U. S. PAT. OFFICE.

The Most Extensive Line of Recording  
 Instruments in the World, Including:

**INSTRUMENTS**

FOR

PRESSURE AND VACUUM .....	RECORDING PRESSURE AND VACUUM GAUGES
LIQUID LEVEL .....	RECORDING WATER LEVEL GAUGES
	BRISTOL-DERR WATER LEVEL FOR STEAM BOILER
TEMPERATURE .....	RECORDING THERMOMETERS
	THERMOMETER-THERMOSTATS
	PYROMETERS INDICATING
	PYROMETERS RECORDING
	THERMO-ELECTRIC TEMPERATURE CONTROLLER
ELECTRICITY .....	RECORDING VOLTMETERS
	RECORDING AMMETERS
	RECORDING WATTMETERS
	RECORDING MILLI VOLTMETERS
	RECORDING SHUNT AMMETERS
	RECORDING FREQUENCY METER
TIME .....	ELECTRIC TIME RECORDER
MOTION .....	MECHANICAL TIME RECORDER
SPEED .....	RECORDING TACHOMETER
MISCELLANEOUS .....	BRISTOL-DURAND RADII AVERAGING INSTRUMENTS
	BRISTOL REVOLUTION COUNTERS
	BRISTOL ENGINE COUNTERS

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# FOR BETTER CONTROL IN THE ICE PLANT



Here are shown how  
some Ice Plants are  
using Bristol's Rec-  
ording Instruments  
to furnish Information  
of—

STEAM LINE PRESSURES  
AMMONIA LINE PRESSURES  
BRINE TANK TEMPERATURES  
STORAGE ROOM TEMPERATURES  
BLOCKS OF ICE PULLED  
Mounted together  
they enable the en-  
gineer to keep a check  
on the entire plant op-  
eration without leav-  
ing the engine room



ELECTRICITY

MOTION, ETC.



FOR



POSITIVE

This instrument in the moisture-proof case is especially adapted for use in the ice plant for recording pressure or vacuum. 8" or 12" Charts may be furnished with this model.



EVERY ice plant engineer knows that to operate at a profit it is necessary to keep close tabs on a thousand and one things which may happen. These include such variables as temperature, pressure, vacuum, and even the actions of workmen.

As a means of checking the correctness of such conditions, many plants are equipped with Bristol's Recording Instruments as outlined in this bulletin. Such Instruments are located at critical points in the system and furnish continuous information of what is taking place. They not only help to guide in making necessary adjustments toward uniform control, but also in locating trouble when it occurs.

#### STEAM PRESSURE CONTROLS PERFORMANCE OF ICE MACHINE

The ice machine being driven at a given speed will compress a given number of cubic feet of ammonia gas per minute. Should the ice machine slow down, because of low steam pressure, an insufficient volume of gaseous ammonia is compressed and liquified. The resulting rise in temperature decreases production.

The expansion valve is set to allow only a definite amount of liquid ammonia to pass into the expansion coil in the brine tank. Then, should the ice machine speed up due to increased boiler pressure, production is not increased unless the expansion valve is reset, and the extra fuel consumed in increasing the boiler pressure is therefore wasted.

Thus, not even considering the undesirable

mechanical effect on the machine itself, it can be readily understood that a varying speed is inefficient.

In the steam operated system it is the steam pressure on which depends the speed and performance of the ice machine. Thus, the first place to practice control of variables is in the power plant. A Recording Pressure Gauge installed on the steam boiler furnishes continuous information of the pressure and guides the engineer in maintaining the right pressure conditions.

As a further aid toward maintaining efficiency in the power plant, many engineers require the use of thermometers for recording temperatures of flue gas—feed water going to the boiler—and water in condenser.

#### ELECTRICAL LOAD ANALYZED

Many ice plants are electrically operated and purchase their energy from power companies and for such, the necessity of constant operating conditions apply as in the steam operated plant. It is essential to know the amount of power consumed and the fluctuations in load from hour to hour and day to day. To furnish this information, Bristol's Recording Wattmeter are used.

#### KNOWLEDGE OF CONDITIONS SURROUNDING ICE MACHINE

The amount of ammonia gas compressed and liquified using the minimum amount of power is the efficiency test for the ice machine.

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### ICE VAULT TEMPERATURE

Very often considerable waste is caused by carrying the temperatures in the storage vault lower than is necessary. The excess refrigerating capacity which is wasted may be diverted into more useful channels if the temperature is maintained within a reasonable limit.

Also by allowing temperature to get too high the blocks melt, run together and when temperature is lowered they freeze and much ice is lost through broken cakes. Therefore, the importance of holding temperature correctly.

A recording thermometer installed in connection with the ice vault furnishes continuous information of the exact temperatures. An instrument may be furnished to install on the outside of vault with the sensitive bulb inside. Thus the temperature can be easily read without going inside the vault, and prevents the unnecessary opening of doors.

### COLD STORAGE TEMPERATURE

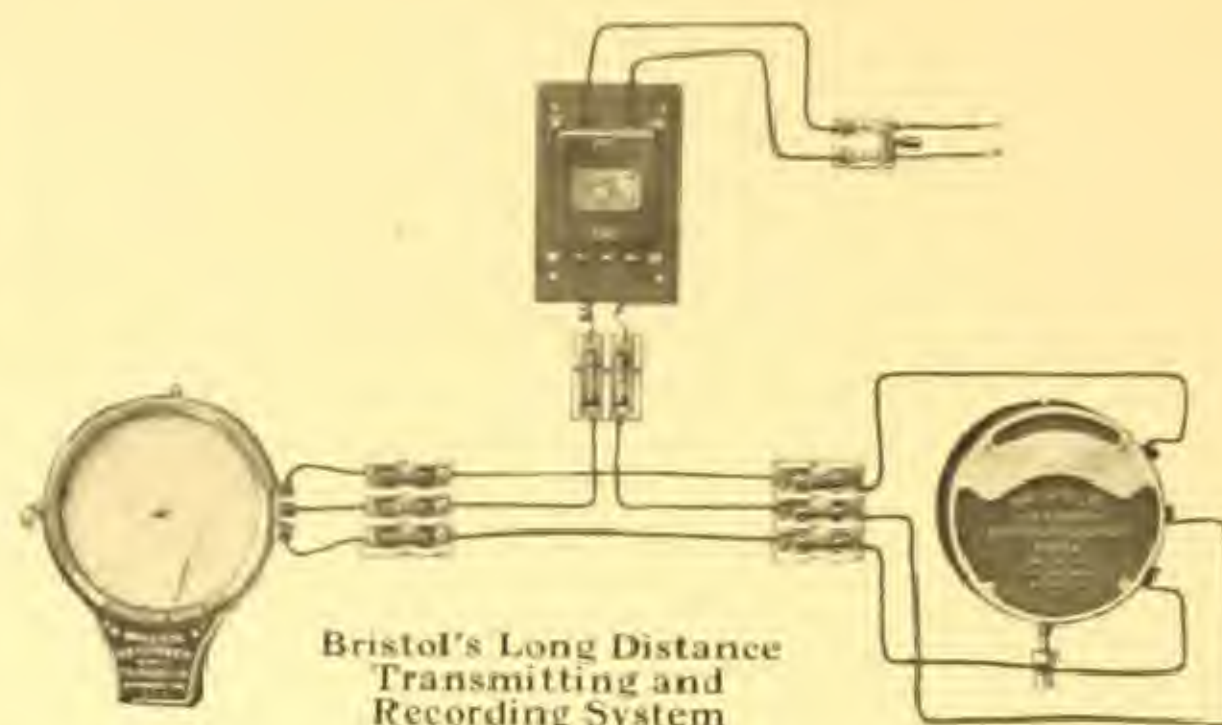
A variety of commodities are placed in cold storage, and the temperature required necessarily varies. Thus, a considerable saving can be made by maintaining the individual storage rooms at that temperature which is best suited to the requirements. For instance, in the case of butter the correct temperature is between 18 and 20° F., while for apples it is 32 to 36° F.

A chart record of these temperatures gives proof as to whether right conditions are being maintained. The same record may also be used as positive evidence to settle any dispute which might arise in regard to goods in storage.

### RECORDING INSTRUMENTS CENTRALIZED

Many engineers find it desirable to have all the recording instruments mounted together on a panel-board so that they afford a complete survey of the plant from a convenient central position in the office or engine room.

Where distances are too great to make the centralized installation possible with the usual recording instrument equipment, Bristol's Electrical Long Distance Transmitting System may be employed. By this means records are transmitted over distances of even several miles, thus the installation within limits of the average plant is not a big undertaking.



Installed together, the recording instruments provide an ideal method of plant supervision.

### RECORDING INSTRUMENTS PREVENT AND LOCATE TROUBLE

Much study has been given by Bristol Engineers to the requirements of ice plants, and experience has proved that the suggestions in this bulletin make a most desirable and practical line-up of recording instruments. Installed in the locations specified they supply the needed information for a well balanced control of the entire plant and a quick means of locating any trouble. Use the service of these engineers in planning for your requirements.

### CHART RANGES

The following are suitable ranges for recording gauges and thermometers to be used in connection with the several applications outlined in this bulletin:

PRESSURE AND VACUUM GAUGES	RANGE
Steam Boiler Pressure.....	0-200 Lbs.
High Side Ammonia Line... 30" MV	0-300 Lbs.
Low Side Ammonia Line... 30" MV	0-150 Lbs.

THERMOMETERS	RANGE
Brine Tank Temperature.....	10-0-90° F.
Flue Gas.....	40-800° F.
Feed Water.....	30-230° F.
High Side Ammonia Temperature...	40-400° F.
Low Side Ammonia Temperature...	10-0-90° F.
Ice Vault Temperature.....	0-100° F.
Cold Storage Temperature.....	0-100° F.

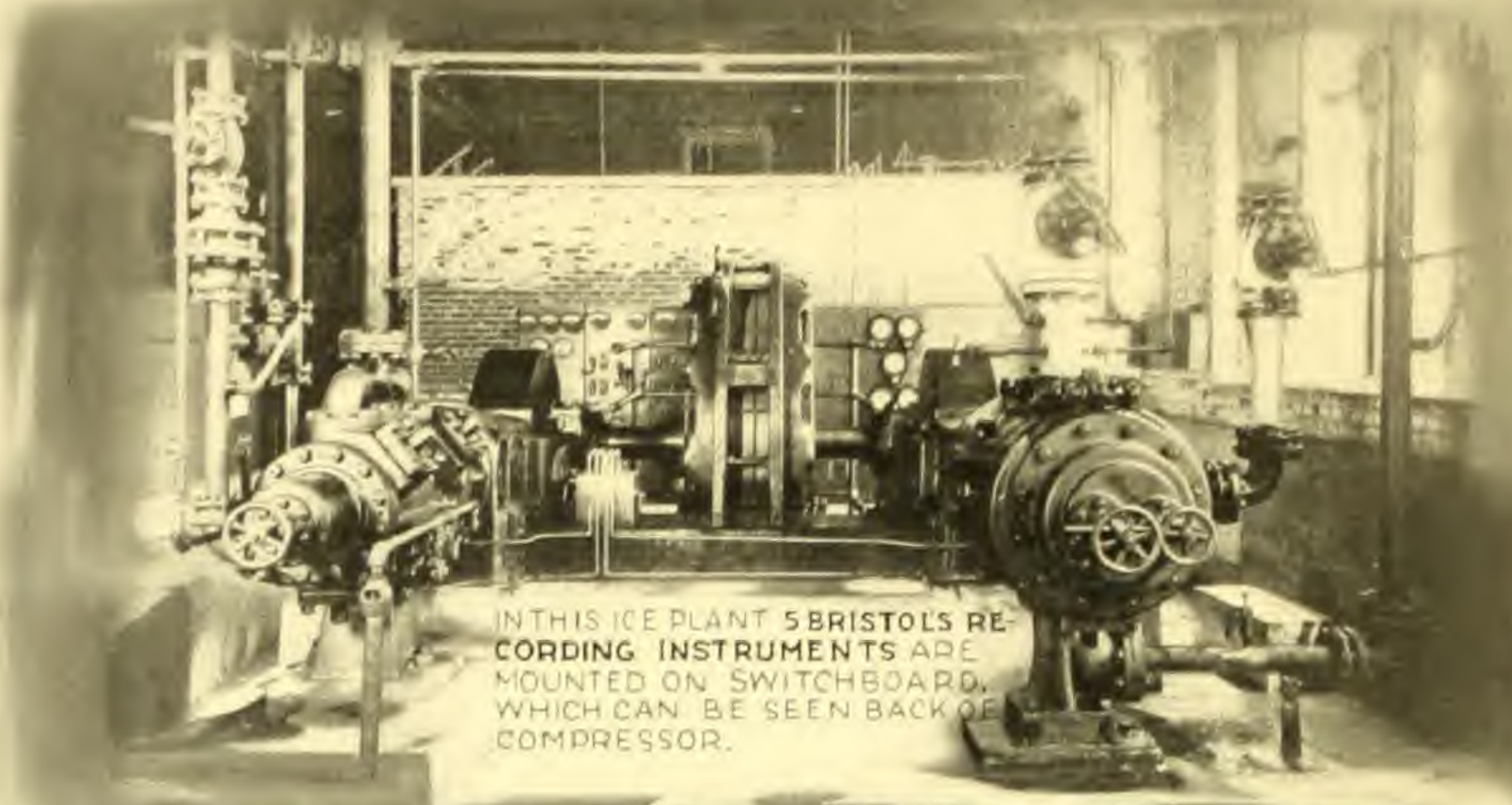


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IN THIS ICE PLANT 5 BRISTOL'S RECORDING INSTRUMENTS ARE MOUNTED ON SWITCHBOARD, WHICH CAN BE SEEN BACK OF COMPRESSOR.



THERMOMETER FOR RECORDING BRINE TANK TEMPERATURE.

EGG STORAGE ROOM TEMPERATURES ARE CONSTANTLY RECORDED ON THESE 4 BRISTOL'S RECORDING THERMOMETERS.



RECORDING THERMOMETER INSTALLED IN CONNECTION WITH BRINE TANK.



ELECTRIC OPERATION RECORDER USED TO COUNT CAKES OF ICE AS THEY ARE DRAWN, ALSO THERMOMETER FOR BRINE TANK TEMPERATURES.

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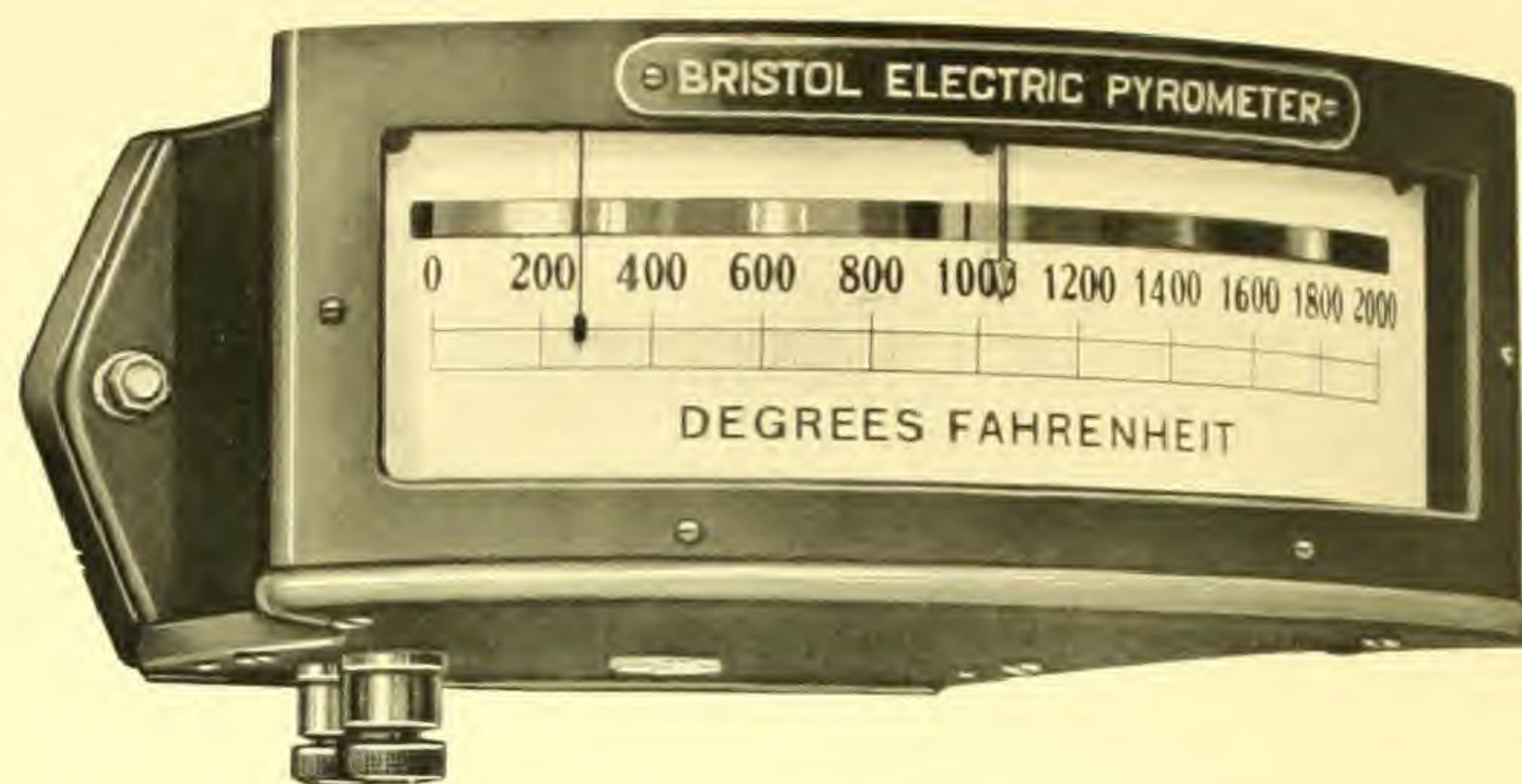


## for Temperatures of Molten Metals

PRINTED IN U. S. A.

MOTION, ETC.





For mounting on wall, Bristol's High Resistance Indicating Pyrometer Model 420

When it is desired to have the Pyrometer Instrument mounted permanently on the wall or other support, the Model 420 shown here is offered.



Equipped with Two Point Lever Switch and Two Leads continuous Pyrometer Service is insured.

This instrument has high resistance movement, is equipped with Automatic Internal Cold-End Compensator, and has an unusually long scale which makes for easy reading.

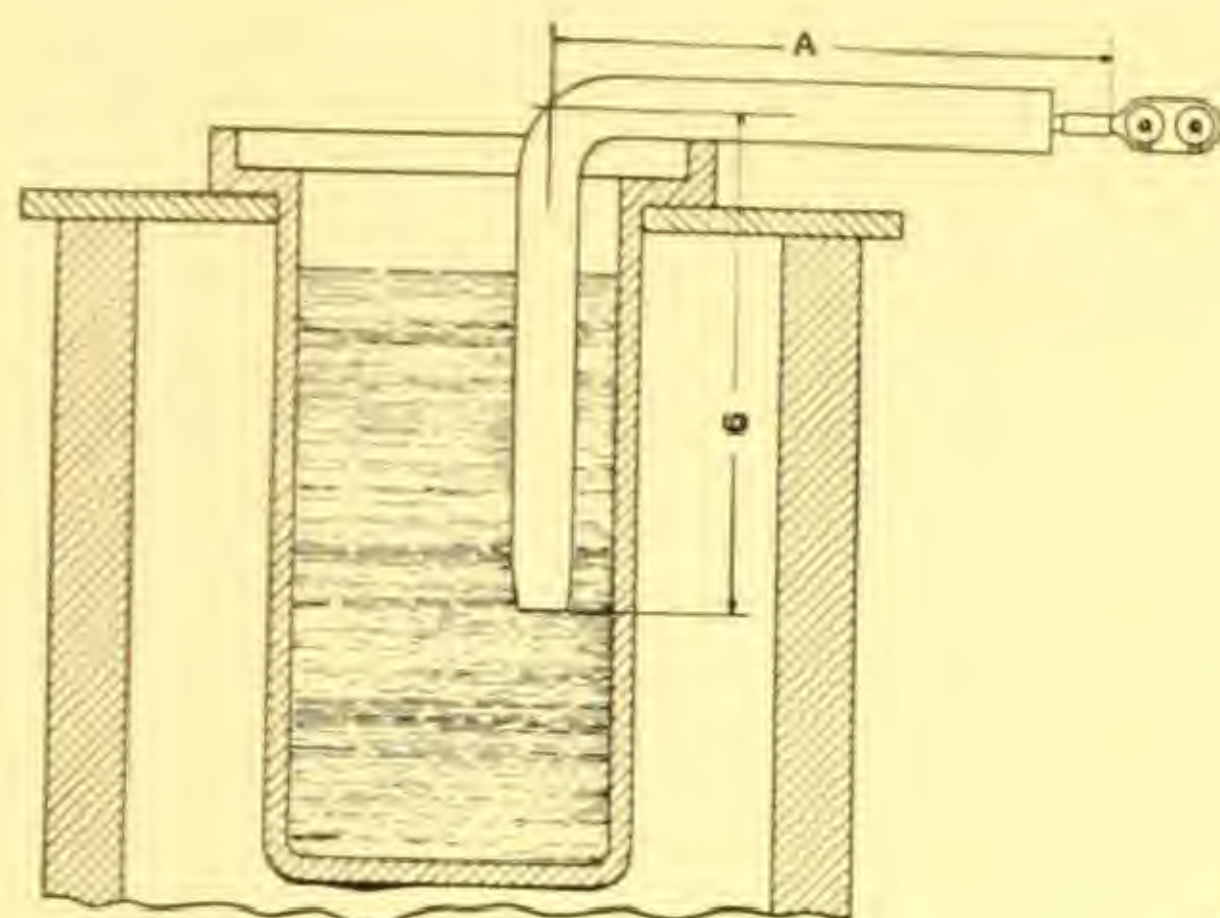
In order to use this type of Pyrometer for taking pouring temperatures, the flexible lead is usually carried overhead and dropped down near to where it will be used. Thus the thermo-couple end is free to manipulate from one crucible to another.

It is necessary to make occasional replacements of thermo-couples for the reason that they deteriorate, caused by chemical action, mechanical wear and strain to which they are exposed. In order to provide uninterrupted pyrometer service, many installations are equipped with two point lever switch and two thermo-couples. With this method a spare is always available. Equipment of this kind is shown in illustration at the left.

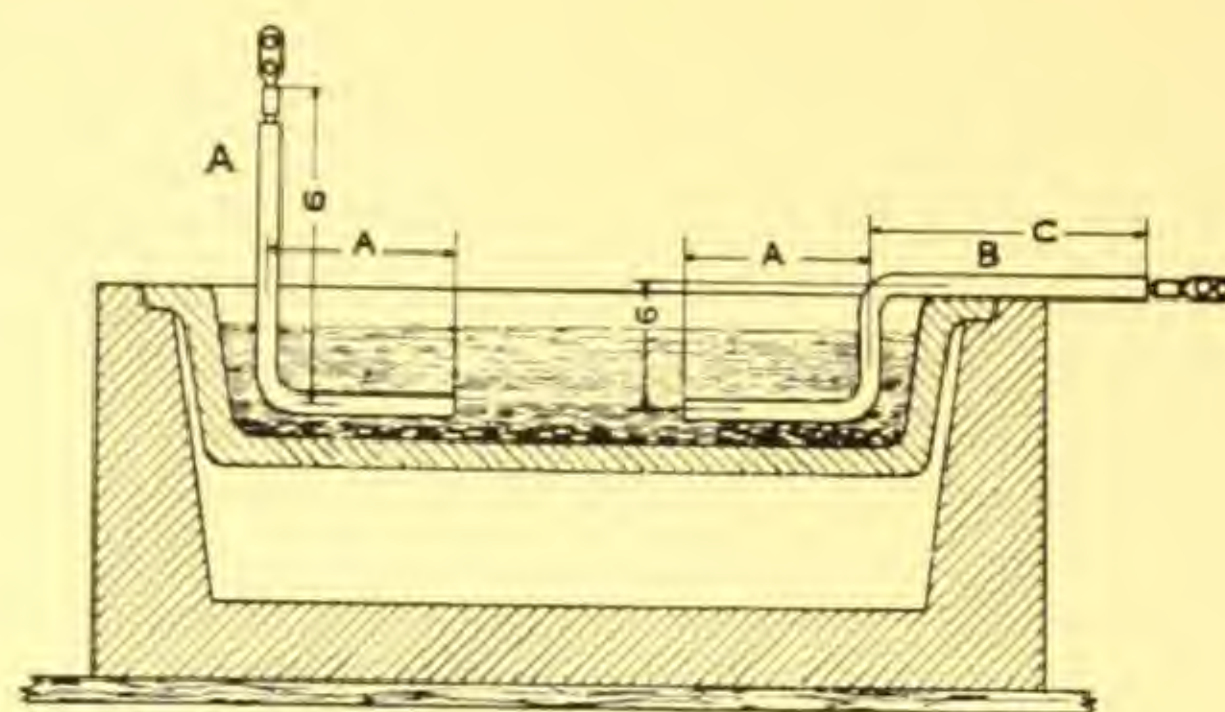
Although the Model 420 case is all metal and dust-proof, the additional wooden case shown in illustration provides a desirable protection, and because of the glass front does not interfere with easy reading.

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Installation of thermo-couple bent at right angles used in metal bath.



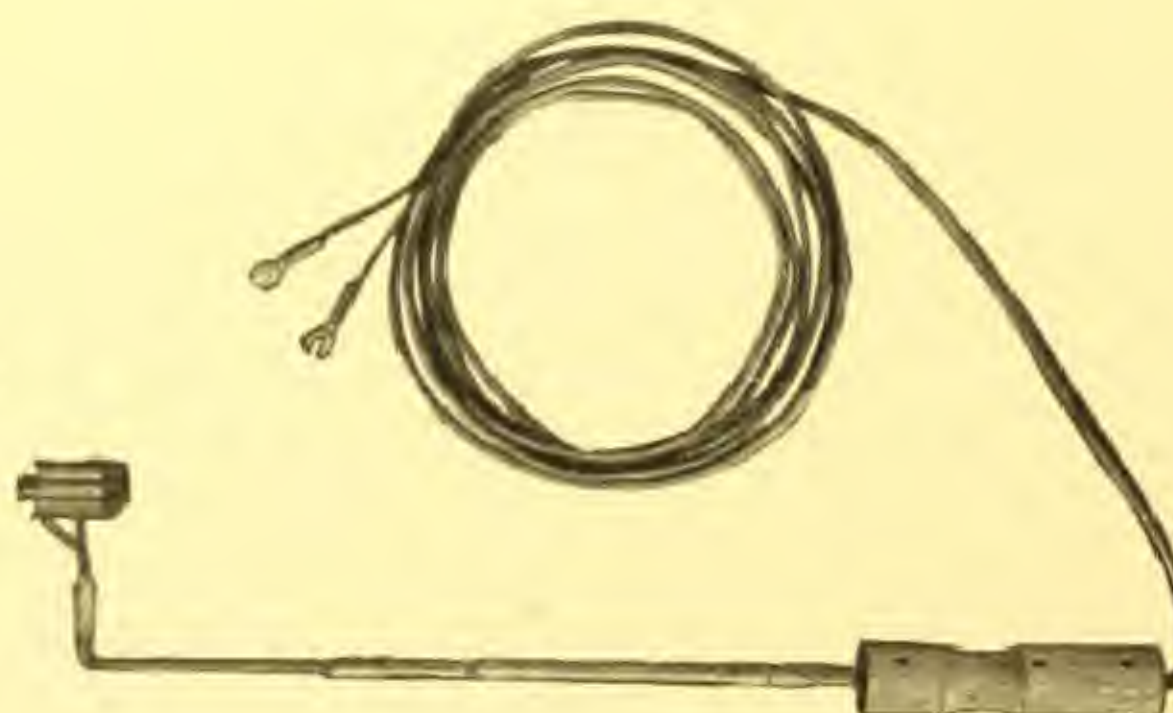
Method sometimes used for installing thermo-couple in shallow metal baths.

It is the thermo-couple or fire-end which comes in contact with the material the temperatures of which are to be measured. The exposure to high temperatures and chemical action peculiar to the various metals make it necessary to select the thermo-couple and the protection to take care of each individual installation.

In the space allowed, it is impossible to go into an exhaustive outline of the thermo-couples which can be used, thus, only a few typical installations are shown.



This type of thermo-couple is specially adapted for taking temperatures of molten brass. The tips, or that part shown below the ferrule may be replaced as required, independently of the rest of thermo-couple equipment.



Surface contact couple for taking quick readings of surface temperature; for instance, frequently used for taking temperatures of steel ingots, zinc castings, etc.

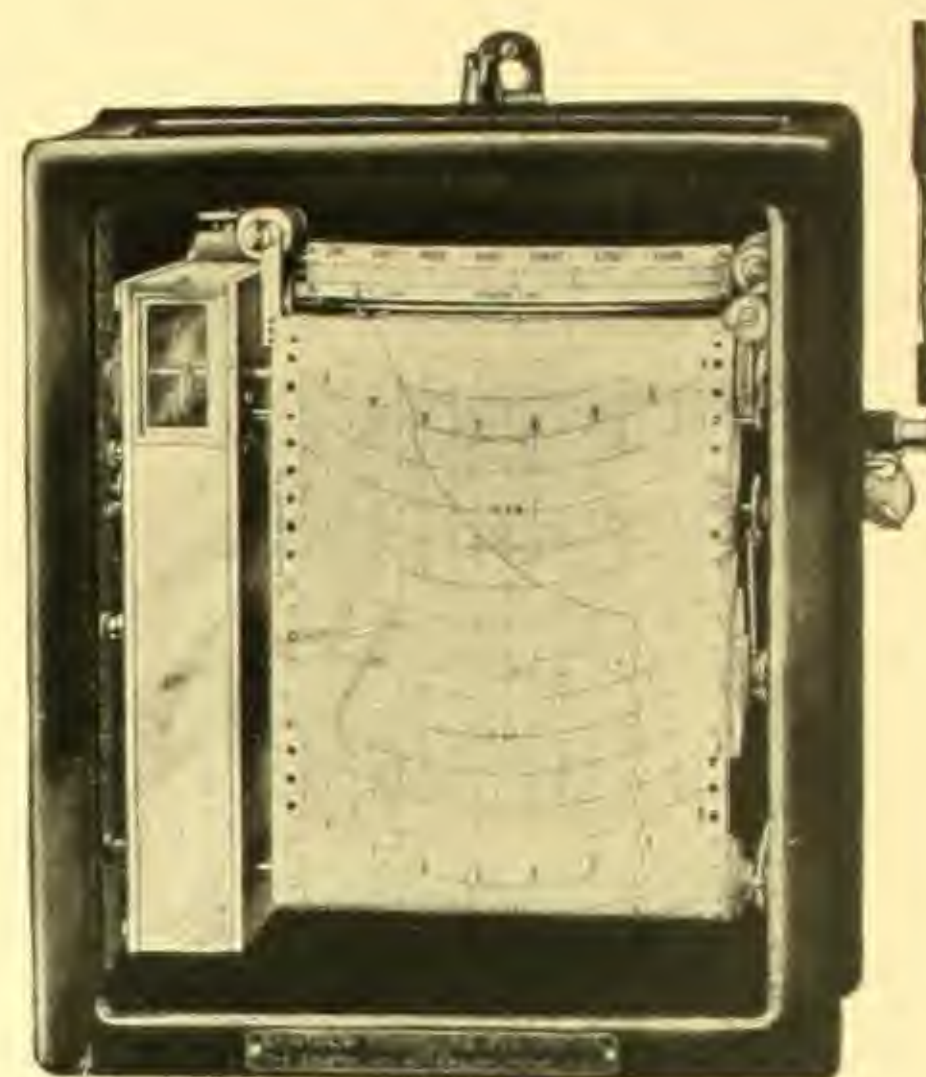
ELECTRICITY

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Round Chart Recording  
Pyrometer, Model 437



Strip Chart Recording  
Pyrometer, Model 425

## RECORDING PYROMETERS

A recording instrument furnishes permanent record of the temperatures of each pouring and also shows the number of pourings.

The pyrometer for recording is usually installed in combination with the indicator, and in this way the indicator is used by the workman to guide him in securing the right temperatures. However, the recorder may be used alone.

Such recording instruments may be furnished with round charts providing records for one day's work, or the strip chart instrument where records of several days or several weeks may be had on the continuous chart.



Recording Thermometer  
with round chart and Moisture-Proof Case, Model 340

## THERMOMETER

for

## CORE OVEN TEMPERATURES

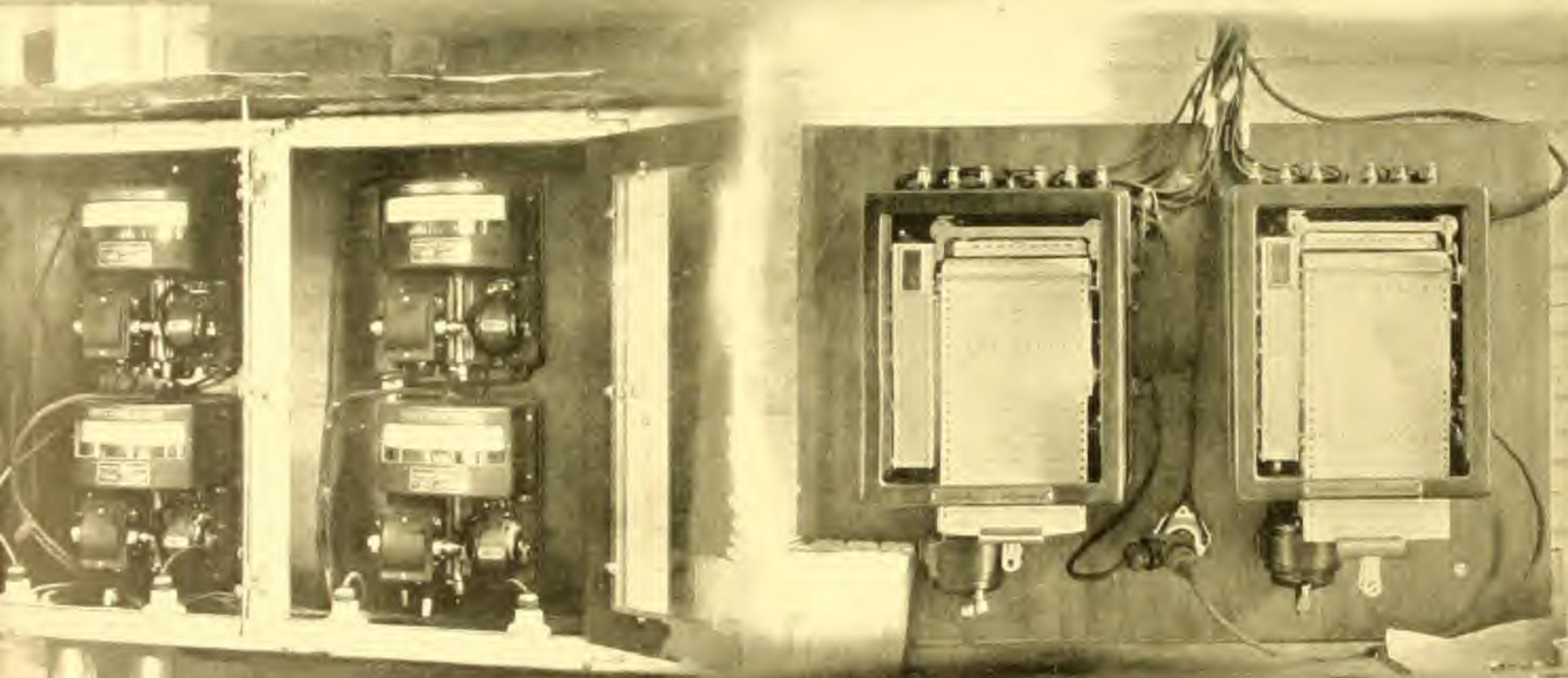
An important process in the casting shop is the proper baking of cores, and here again temperature control is the big thing.

Bristol's Recording Thermometers, like that shown here, with the range up to 1000°F. furnish a convenient means of knowing the temperatures in the oven and a definite record of those temperatures throughout the day.

The record, as it is made on the chart, guides in the control of oven temperature, and also furnishes a record which may be filed for future reference.



# Automatic Temperature Control Used For Heat Treating Steel



*Bristol's  
Pyrometer  
Controller  
Model 479  
Installed at  
Denver Rock Drill  
Co.*

ELECTRICITY

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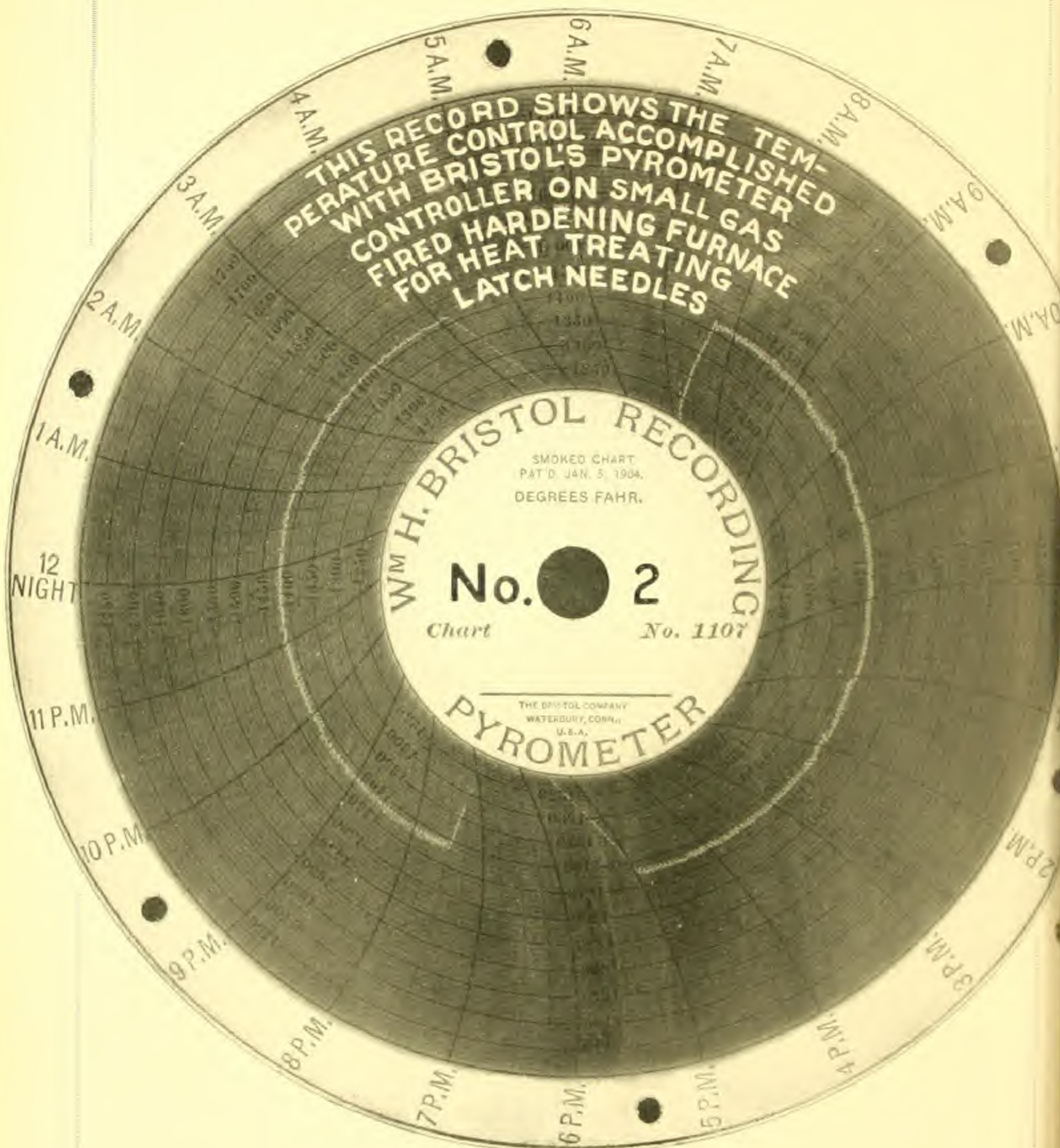










Fig. 2481

## PYROMETER CONTROLLER MODEL 479

This Pyrometer Controller is used to operate motor driven or solenoid valves for automatically regulating the flow of fuel and air in connection with gas or oil fired equipment, and for operating magnet switches for controlling electrically heated apparatus.

The result of four years experimental work and trial under actual operating conditions, the Model 479 Pyrometer Controller described here not only includes recent improvements in Bristol's Pyrometric Equipment, but also incorporates additional and exclusive features.

### IMPORTANT FEATURES

1. 7-Inch Scale, longest used at the present time in any thermo-electric control.
2. Point of control is easily adjustable from outside bottom of case.
3. Safety adjusting mechanism.
4. "Weston" High Resistance Milli-Voltmeter movement specially designed for control apparatus.
5. Automatic cold-end compensation.
6. Impossible for pointer to pass temperature setting without making contact.

7. All parts are easily accessible and interchangeable.
8. All bearings are provided with efficient oilers.
9. Motors available for all standard voltages and frequencies.
10. Dust-tight case.

### TEMPERATURE RANGE

The equipment is suitable for controlling temperatures up to 3000°F., and is used in connection with all kinds of heat treating processes, including annealing, patenting, carbonizing, japanning, drying, baking, burning, etc.

Some of the standard scale ranges are:

50 to 800°F.	0 to 2100°F.
50 to 1100°F.	0 to 2500°F.
0 to 1600°F.	0 to 3000°F.
0 to 2000°F.	

### CLOSE TEMPERATURE REGULATION

Tests made with the Pyrometer Controller Model 479 prove that a movement of the pointer which is too small to be observed with the naked eye decides whether contact is made on the high or low side.

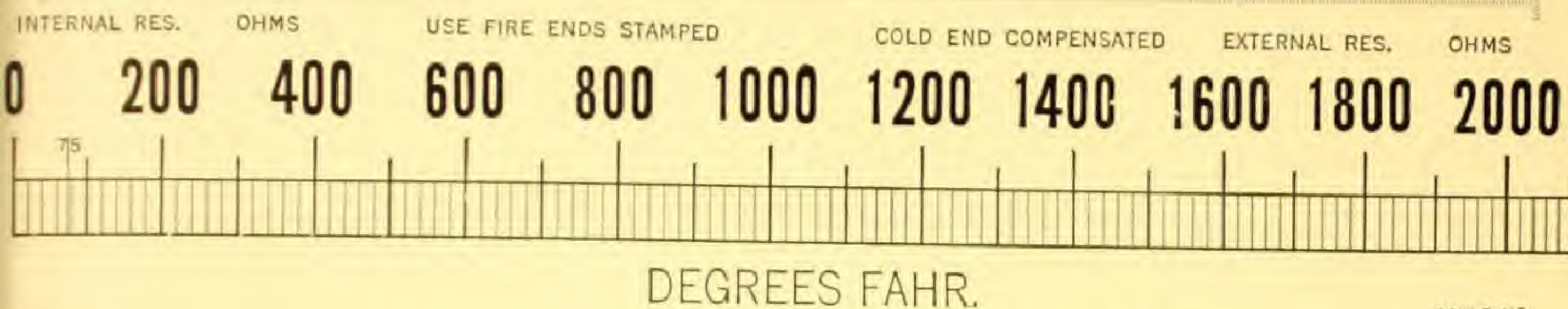
In the past, when close control has been imperative, partial scale instruments were specified, although it was recognized that their use was inadvisable. The increased temperature errors of set back scale instruments, the fact that the armature control springs are always in excessive tension, and the force with which the pointer comes back against the stop when the leads are disconnected, all these factors tend to make the partial scale instrument unnecessary.

Now the extremely close operation of the Model 479 eliminates the need for partial or set back scales because it will control even more closely than can be read on a normal scale.

### EXTRA LONG SCALE

The extra long 7-Inch scale furnished on Model 479 makes it easy to read to a very close degree of accuracy. It is the longest scale used in connection with any pyrometer controller so far placed on the market. In fact, it is the same as that furnished on Bristol's Indicating Pyrometer Model 420.





Reproduction in actual size of scale used with Pyrometer Controller Model 479

### SAFETY ADJUSTING MECHANISM

To set the pointer to the degree of temperature which it is wished to maintain, it is only necessary to turn an adjusting knob on the outside of the case.

In order that the setting of the pointer may not be accidentally shifted, the adjusting knob is protected by a spring hinged cover. Thus the adjusting knob cannot be operated until the cover is opened, and furthermore, the act of opening the cover automatically carries the switch mechanism to the lowest position where it is entirely free from pointer. With this device there is positively no opportunity for the millivoltmeter movement to be damaged when changing the point of control.

### SPECIALLY DESIGNED MOVEMENT

The millivoltmeter movement used is specially designed by "Weston" for controller use. It has a sensitivity of 10 ohms per milli-volt. Laboratory tests prove that so far as the instrument is concerned, Model 479 is capable of controlling temperatures to within 1°F. plus or minus. In fact, the regulation is too close to even see the pointer change its position.

### PERFECT ALIGNMENT OF SWITCH AND OTHER PARTS

The millivoltmeter movement is adjusted so that the pointer swings in a plane absolutely parallel to the course of the switch. As a result, the switch operates with certainty at any part of the scale arc.

There is no lateral thrust on the pointer and no force along the pointer arm toward the pivots. The very short distance (only 1/32-Inch) which the contact mechanism travels reduces the pressure applied to the pivots to an almost negligible amount.

The capacity of the contact is 250 volts, 100 watts, 1 ampere.

### DRIVING MOTOR GOVERNOR

An improved governor is used to regulate the speed of driving motor. All parts of the governor mechanism and gears are accurately aligned and doweled to maintain permanent adjustment.

The mechanism which transmits power from the cam to the switch causes the switch to move up and down about four times a minute. To insure against slipping or any possible change in adjustment here, every joint is pinned.

The motor with horizontal axis is connected to the driving shaft by means of a non-metallic coupling, which reduces friction and noise.

### NICETY OF OPERATION

If the pointer is near the desired temperature, whether contact is made on the high or low side is decided by a knife-edge switch. The pointer is depressed on either side of a knife-edge and there can be no neutral position.

### AUTOMATIC COLD-END COMPENSATION

The usual cold-end error inherent in thermo-electric pyrometry is eliminated in the Model 479 by use of a simple compensator originated by The Bristol Company, and known as the Bristol's Patented Automatic Internal Cold-End Compensator. By its use the readings on the scale are accurate and no correction for temperature change is necessary. This compensator is part of the standard equipment and is regularly furnished.

### DUST-TIGHT CASE

The case is all metal, of ample proportions, and dust-tight to fully protect working parts. It is mounted on a strong metal back.



### ACTUAL PERFORMANCE

The final test of any equipment is in the performance under actual operating conditions. The installations of Model 479 Pyrometer Controllers in various parts of the country are operating successfully.

The illustration on the front cover shows eleven of these Controller Instruments installed at Denver Rock Drill Manufacturing Company, Denver, Colorado.

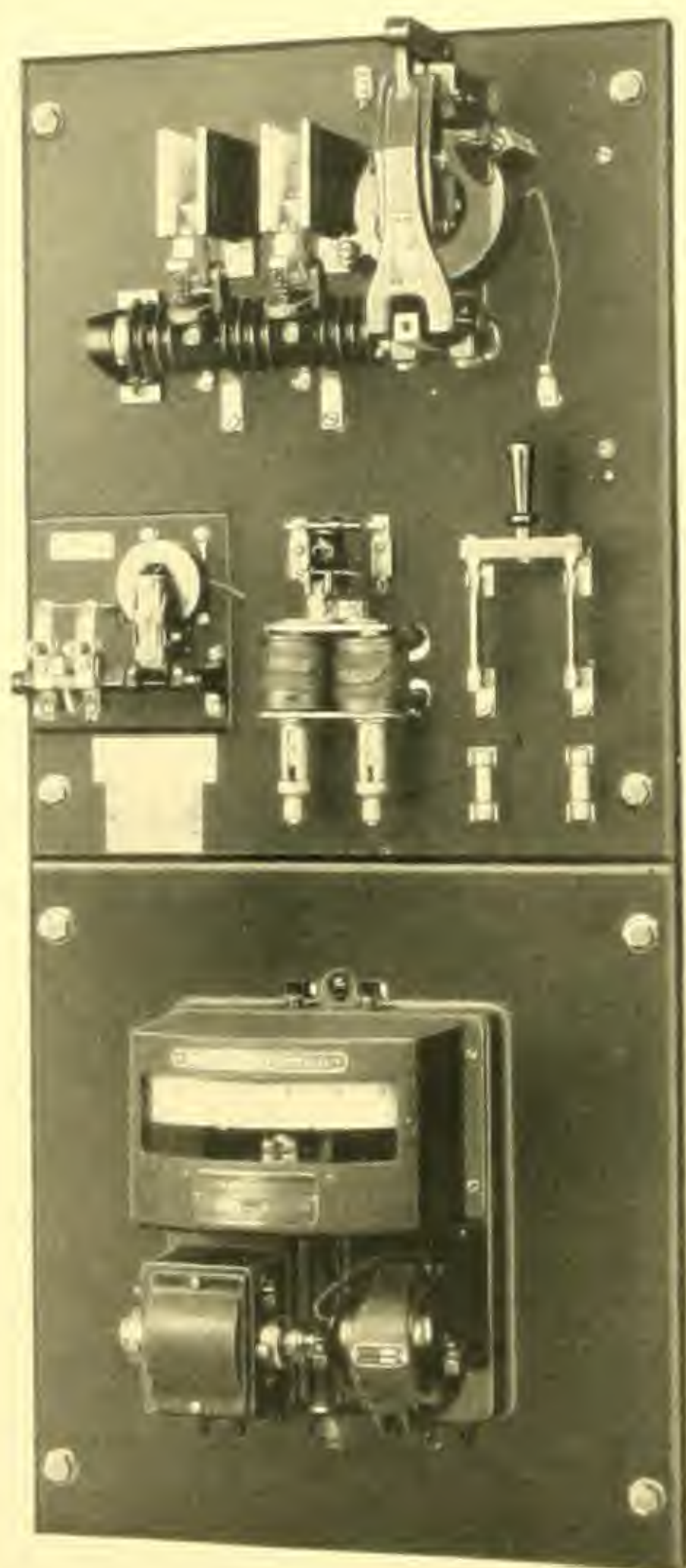


Fig. 2608

Model 479 installed in connection with line switch and relay, for controlling temperatures of electrically heated apparatus.

### CONTROLLER VALVES

To use in connection with Pyrometer Controller Model 479, control valves may be furnished in either the solenoid or motor operated types.

Bristol's Motor Operated Valves shown here are specially designed for use in controlling the flow of air and gas, air and oil, steam and oil; also for air, gas, steam, oil, and other liquids. These valves are positive in operation and can be depended upon for close regulation. The proportions are ample so that ducts are easily kept clean from impurities in fuel material.

In the industrial field, the details of installations vary considerably. However, Bristol's Motor Operated Controller Valves can be furnished in unique combinations of units which gives the necessary flexibility to take care of practically every installation encountered.

It is impossible to describe in this space the detailed variations, but separate bulletin devoted entirely to Bristol's Motor Operated Controller Valves will be furnished on request.

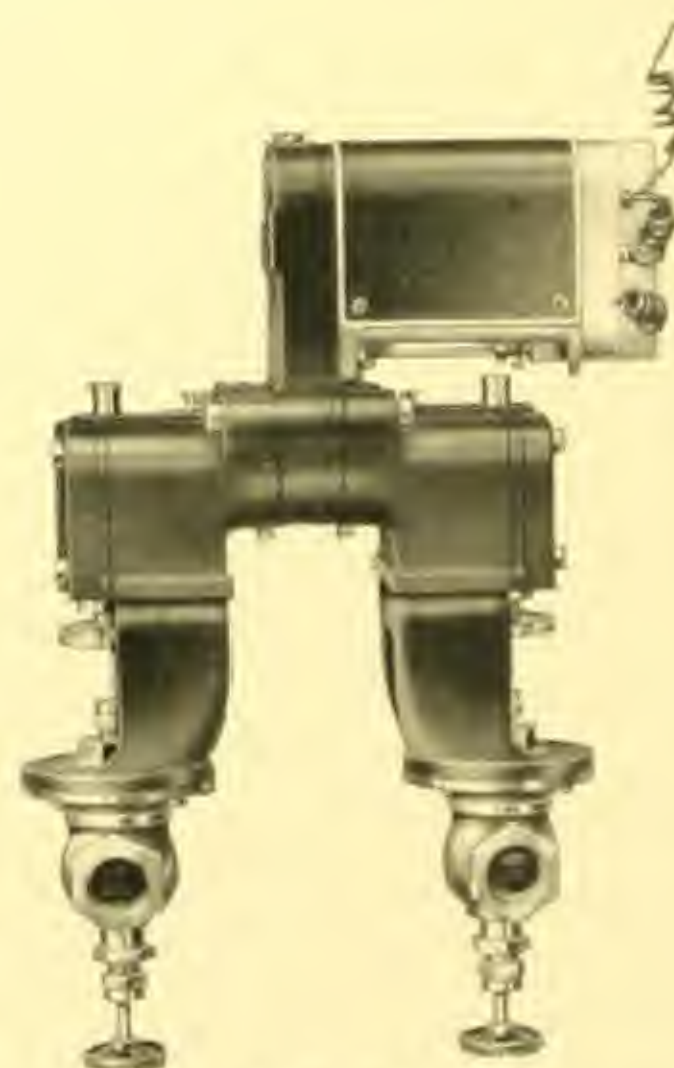


Fig. 2056

Controller Valve for air and gas, used where feed pipes are in horizontal position.





Fig. 2060

Controller Valve used for air, gas or mixed gas and air.

## FIRE-ENDS

The fire-end is that part of the Pyrometer Controller equipment which is inserted into the furnace, oven, etc., of which the temperature is to be controlled. A duplex wire lead connects the fire-end with the instrument.

Because the fire-end is exposed to chemical fumes and gases, a variety of temperature ranges, and certain mechanical strains, it is necessary that all these factors be taken into consideration when specifying for the installation in hand.

There is a big variety of Bristol's Fire-ends and Protection Wells to select from. Only a few of the more commonly used ones are shown here.



Fig. 1593

Fire-End in iron Protection Well.



Fig. 1594

Fire-End in iron Protection Well with adjustable flange.

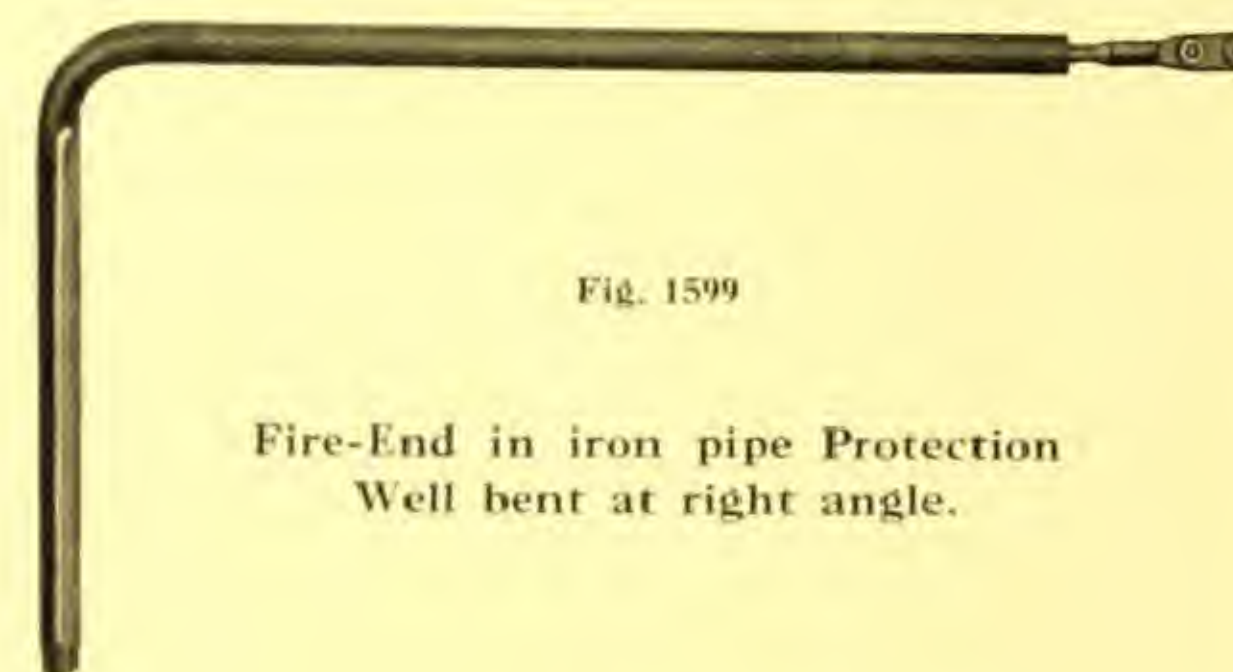


Fig. 1599

Fire-End in iron pipe Protection Well bent at right angle.

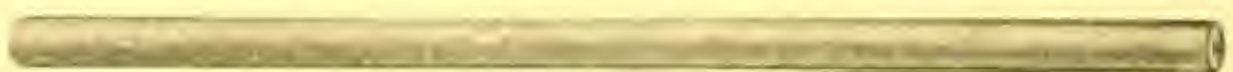


Fig. 1585

Calorized Steel Protection Well, used for intermittent temperatures up to 1700° F. and for continuous temperatures of 1600° F.



Fig. 1586

Protection Well of Nichrome welded to iron pipe, used for intermittent temperatures up to 2500° F. or continuous temperatures of 2300° F.

MOTION

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MOTION, ETC.



## RECORDING PYROMETERS

The Recording Pyrometer when used alone in connection with heat treating processes, gives much valuable information for the control of temperature. They are

also extensively used in conjunction with automatic control equipment as a check on the process itself and accuracy of the control apparatus.



Fig. 2473

ROUND CHART RECORDING PYROMETER MODEL 437, with high resistance millivoltmeter movement, and used for recording temperatures up to 3000°F. This instrument employs the frictionless smoked-chart recording system.

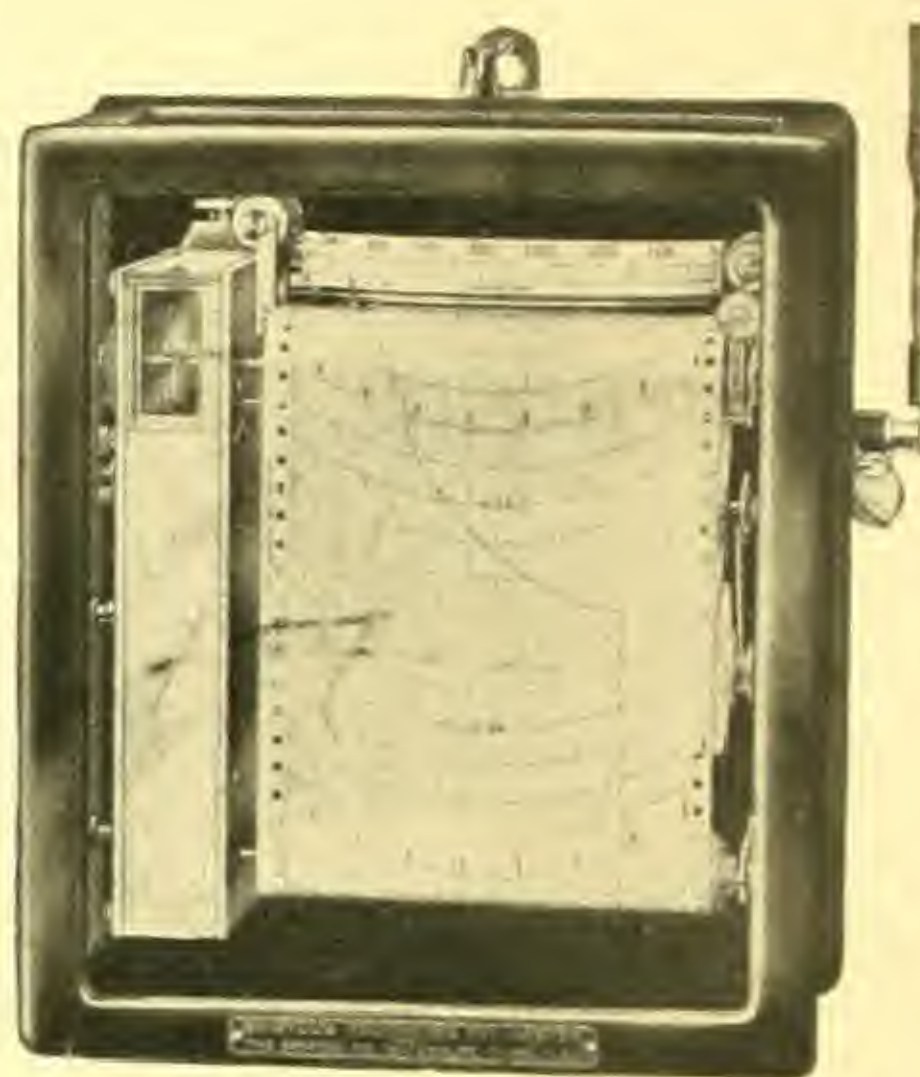


Fig. 1497

STRIP CHART RECORDING PYROMETER MODEL 425, for Single Record. This instrument has high resistance movement and uses a 90-foot chart roll which gives an unbroken record for forty-five days duration.

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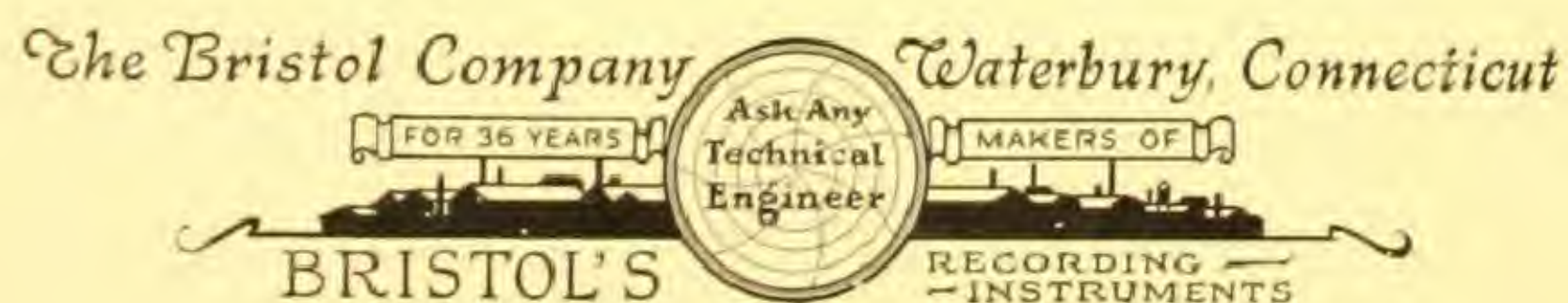
TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE

# BRISTOL'S—

## Help to Make Heat Treating an Exact Science

**S**UCCESSFUL heat treating does not depend entirely on any one thing, but on many contributing conditions. To measure and record these various factors is the function of Bristol's Instruments and in this way assist in securing the desired predetermined results.

On these pages are shown some of the Bristol's Instruments and data on where they fit into the Heat Treating Department.



UTILITY

ELECTRICITY

MOTION, ETC.



## PYROMETERS—Indicating and Recording

To measure the temperatures in the furnace, Bristol's Thermo-Electric Pyrometers are used. They include indicating and recording instruments for permanent installation, and portable models for test purposes.

The indicating instrument is most often located near the furnace to guide the operator, and the recorder in the superintendent's office where it may be referred to as a check on operation. The ideal way is to have a pyrometer instrument for each furnace, but where this is not practical, selective switching equipment is available, so that any required combination of indicators and recorders can be supplied to suit individual needs.

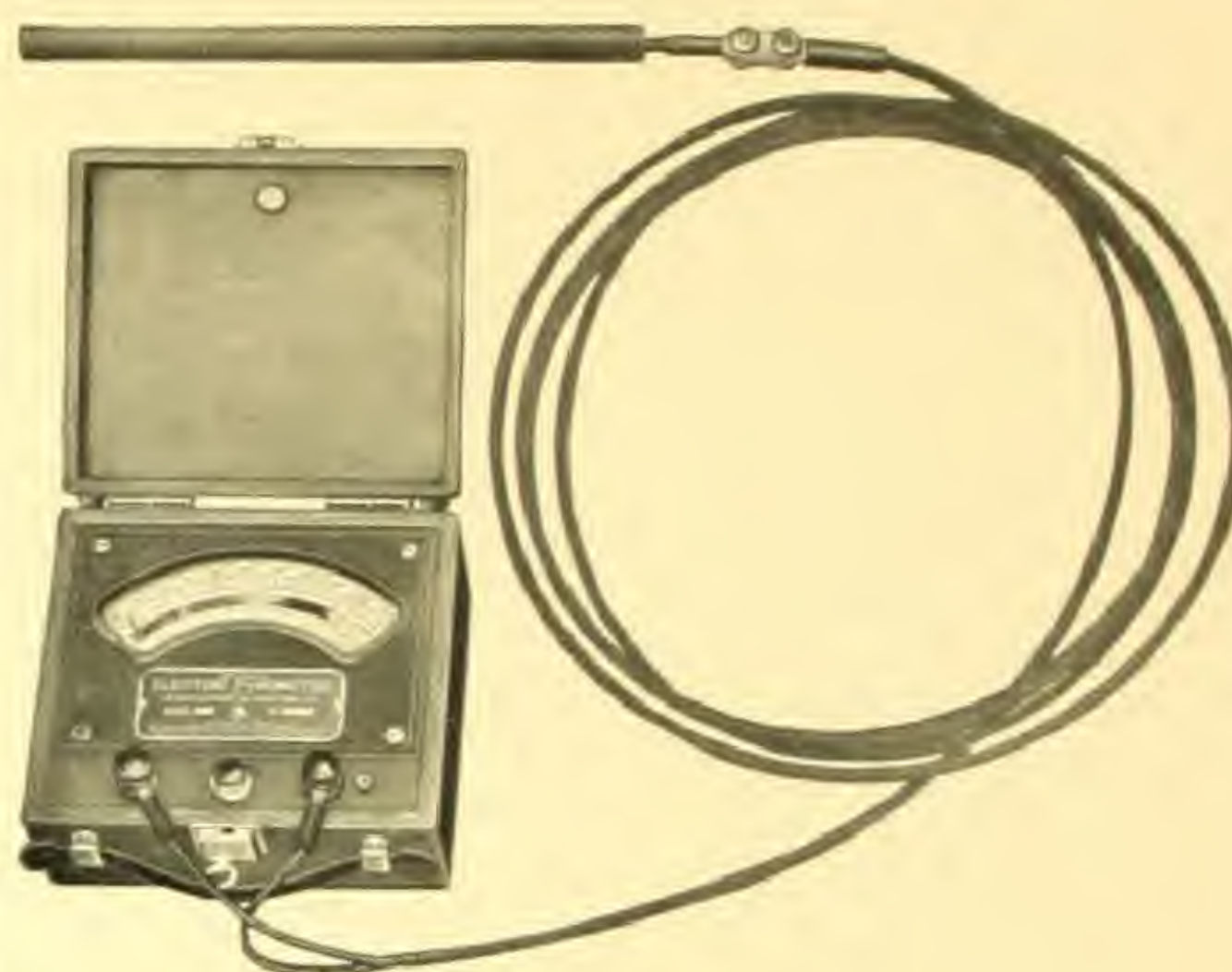
In many plants, however, they consider the recorder is more efficient for the operator to use, and thus install it alongside the indicating instrument. The recorder not only shows what has already taken place in the temperature cycle, but the general trend, whether upwards, downwards or uniform. With this information before him, the operator is able to effect closer control with less effort.

Recording pyrometers are available in round chart type, also in strip chart or ribbon form. The latter can be furnished for single records or any number of records up to six, on the same chart.

Thermo-Couples with suitable protections can be supplied for all kinds of work.



**INDICATING PYROMETER MODEL 420** equipped with high resistance movement and wide open easy to read scale. Furnished for all ranges up to 3000°F.



**PORTABLE INDICATING PYROMETER MODEL 322** is particularly adapted for taking temperatures of molten metal or used as a portable test pyrometer.



**INDICATING PYROMETER MODEL 410.** This pyrometer is used for measuring temperatures up to 2500°F. It is a very rugged instrument and will stand up under even hard usage, which makes it desirable to use in many places in the plant.

ROUND  
PYROMETER  
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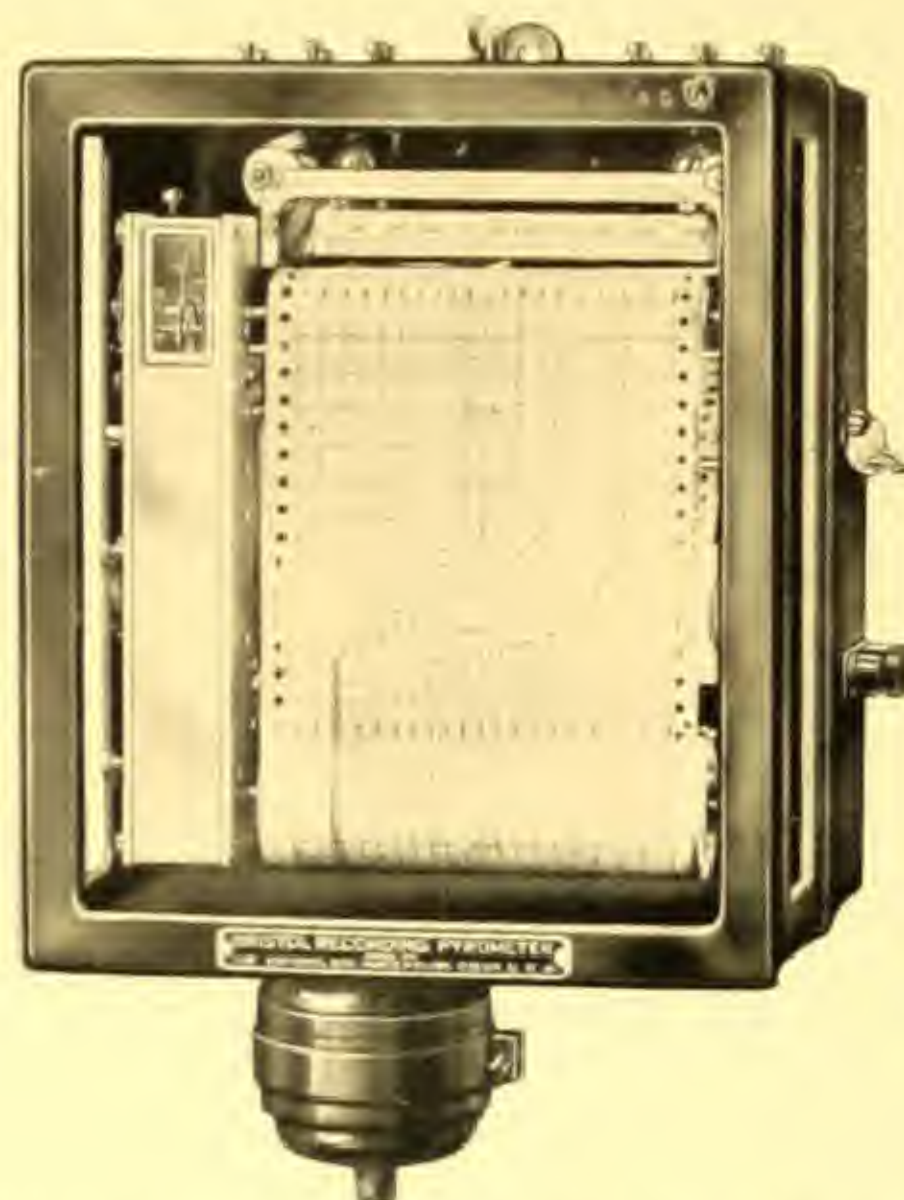
STRIP  
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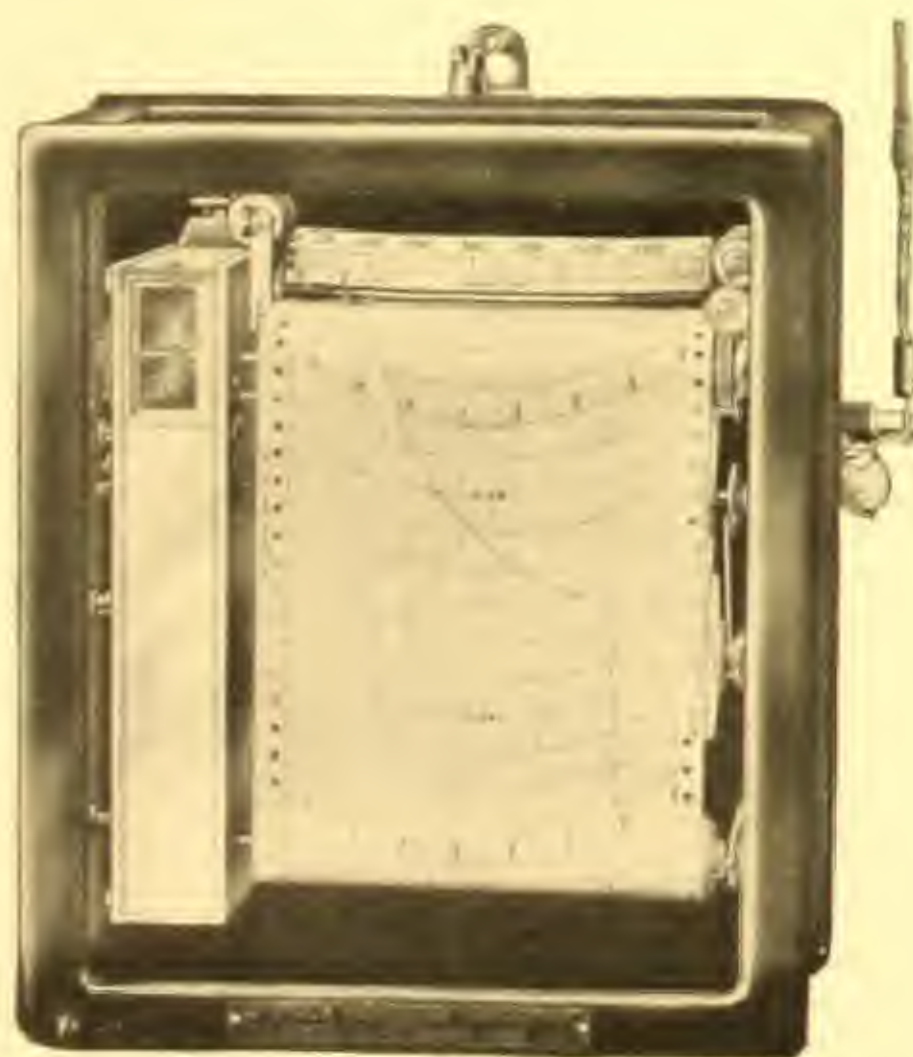
## PYROMETERS—Indicating and Recording



**ROUND CHART RECORDING PYROMETER MODEL 437**, with high resistance millivoltmeter movement, and used for recording temperatures up to 3000°F. This instrument employs the frictionless smoked-chart recording system.



**MULTIPLE RECORDING PYROMETER MODEL 425**. This instrument can be furnished to make as many as six records on the one chart at the same time. The recording medium is a multi-colored ribbon and a color for each fire-end connection, so that each record is readily distinguished.



**STRIP CHART RECORDING PYROMETER MODEL 425**, for Single Record. This instrument has high resistance movement and uses a 90-foot chart roll which gives an unbroken record for forty-five days duration.



**DUPLEX RECORDING PYROMETER MODEL 425**. A strip chart with two complete scales is used with this instrument and gives two records side by side. Such a pyrometer is particularly valuable where comparative records are desired.

ELECTRICITY

ELECTRICITY

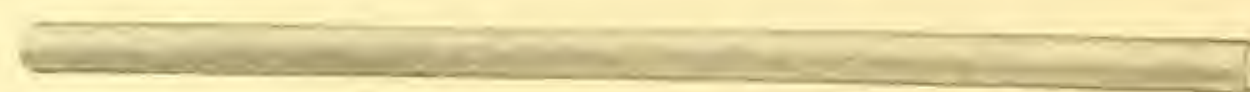
MOTION, ETC.



## PYROMETERS—Indicating and Recording



**MULTIPLE ROTARY SWITCH** for making connections to twenty different fire-ends. Similar switches can be furnished for five or ten connections. This switch has water-proof case and all features to make it convenient and reliable.



Calorized Steel Protection Well, used for intermittent temperatures up to 1700°F and for continuous temperatures of 1600°F.



Protection Well of Nichrome welded to iron pipe, used for intermittent temperatures up to 2500°F or continuous temperatures of 2300°F.

## Automatic Temperature Control

It is an indisputable fact that for such kinds of work where it can be applied, the highest degree of accuracy in heat treating methods is secured with automatic control. Automatic Temperature Control can be depended upon to continuously repeat right conditions and, furthermore, wonderful savings are made because there is no loss by spoiled work, and usually an economy in fuel follows.

For gas, oil and electrically heated equipment, Bristol's Controllers can be used for temperatures up to 3000°F. The instruments function as thermostats and are used to operate motor driven valves for gas and oil, and in the case of electricity relays and switches. For the lower temperatures a thermometer type of instrument is used; on the higher temperatures the thermo-electric pyrometer principle is applied.

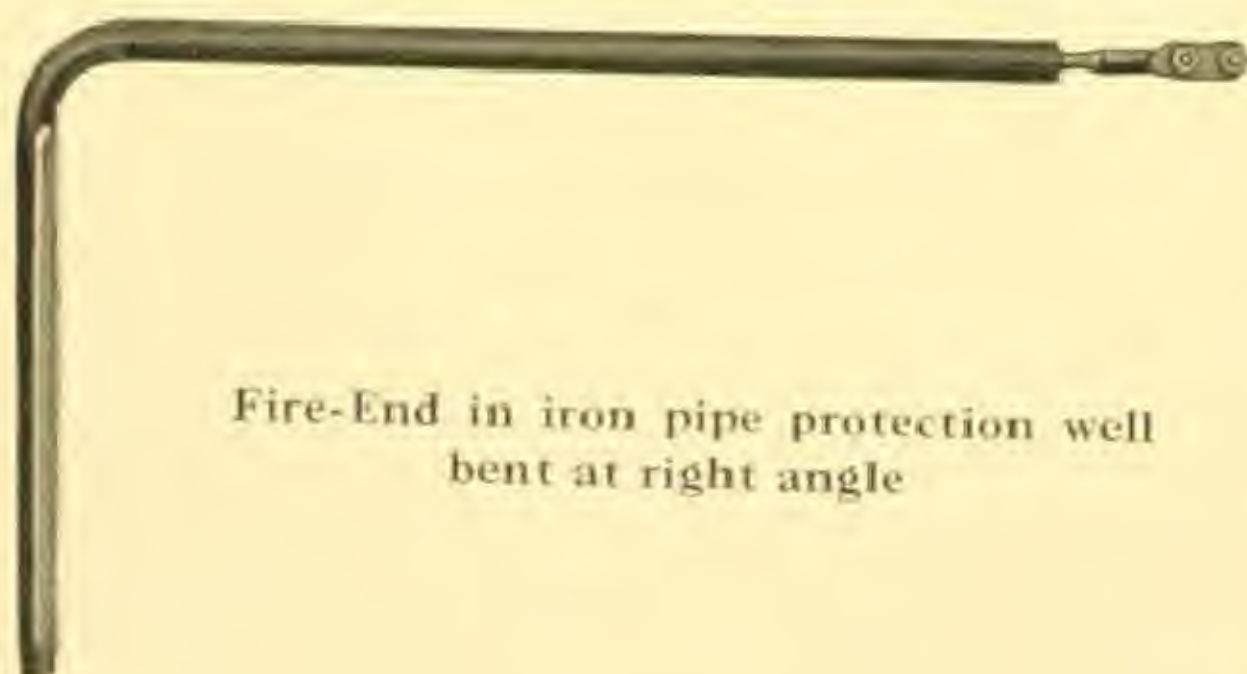
The Bristol Motor Operated Controller Valve is designed for use on Gas and Air, Oil and Air. It is very positive in operation and combinations of valve units are available which insure interchangeable parts and unique flexibility. The proportions are ample, so that ducts are easily kept clean from impurities in fuel material. In one nationally known plant over one hundred of the valves have been installed.



Fire-End in iron protection well



Fire-End in iron protection well with adjustable flange



Fire-End in iron pipe protection well bent at right angle

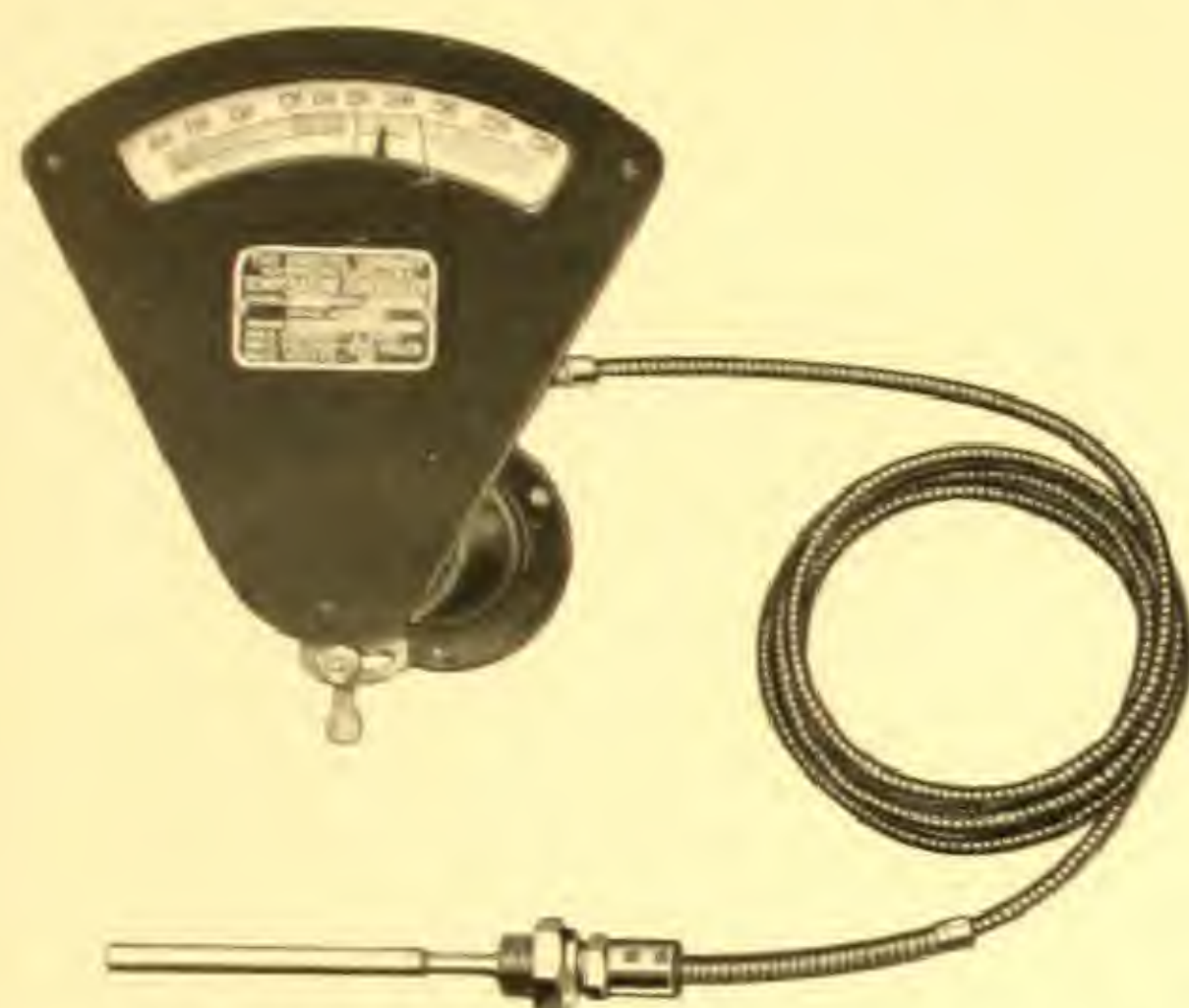
TEMPERATURE  
MODEL  
the vapor  
temperature  
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that it is  
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PYROMETER  
MODEL 479  
high resistance

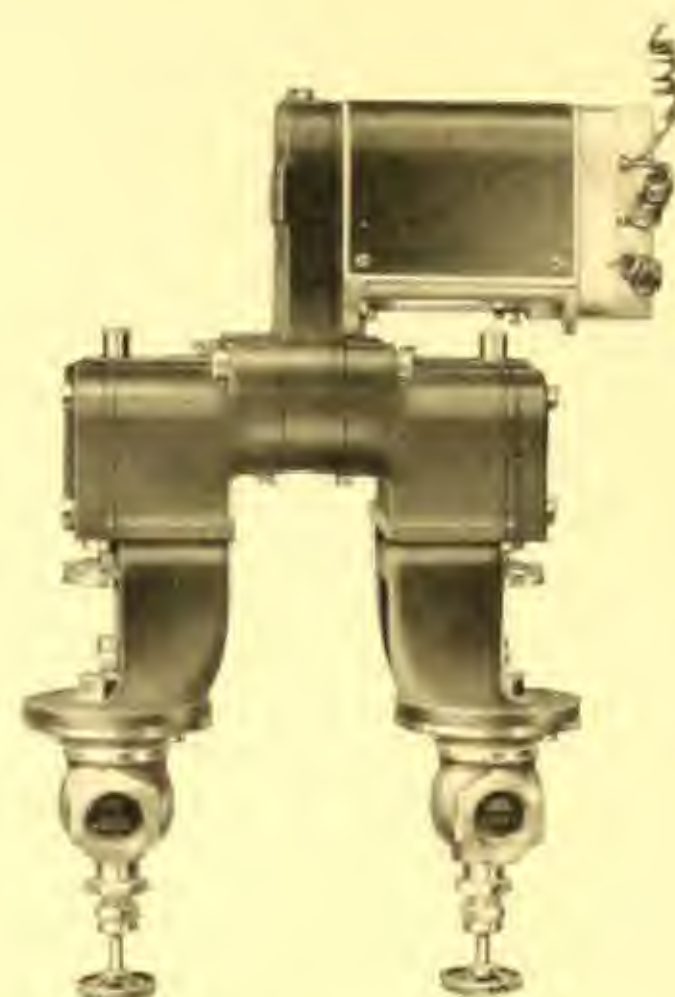


## AUTOMATIC TEMPERATURE CONTROL



be used for all temperatures up to 3000°F. It has an extra wide scale, motor drive, external contactor adjustment, and is easily accessible to working parts, for adjustment and oiling.

**TEMPERATURE CONTROLLER MODEL 277.** This equipment operates on the vapor tension principle and is used for temperatures up to 500°F. It is equipped with dual external contactor adjustment so that it is not necessary to open the case to make changes. A similar equipment can be furnished in a flush type model for mounting on panel board.



Controller Valve for air and gas, used where feed pipes are in horizontal position.



**PYROMETER CONTROLLER MODEL 479.** In this Controller is used a high resistance pyrometer movement and can



Controller Valve used for air, gas or pre-mixed gas and air.

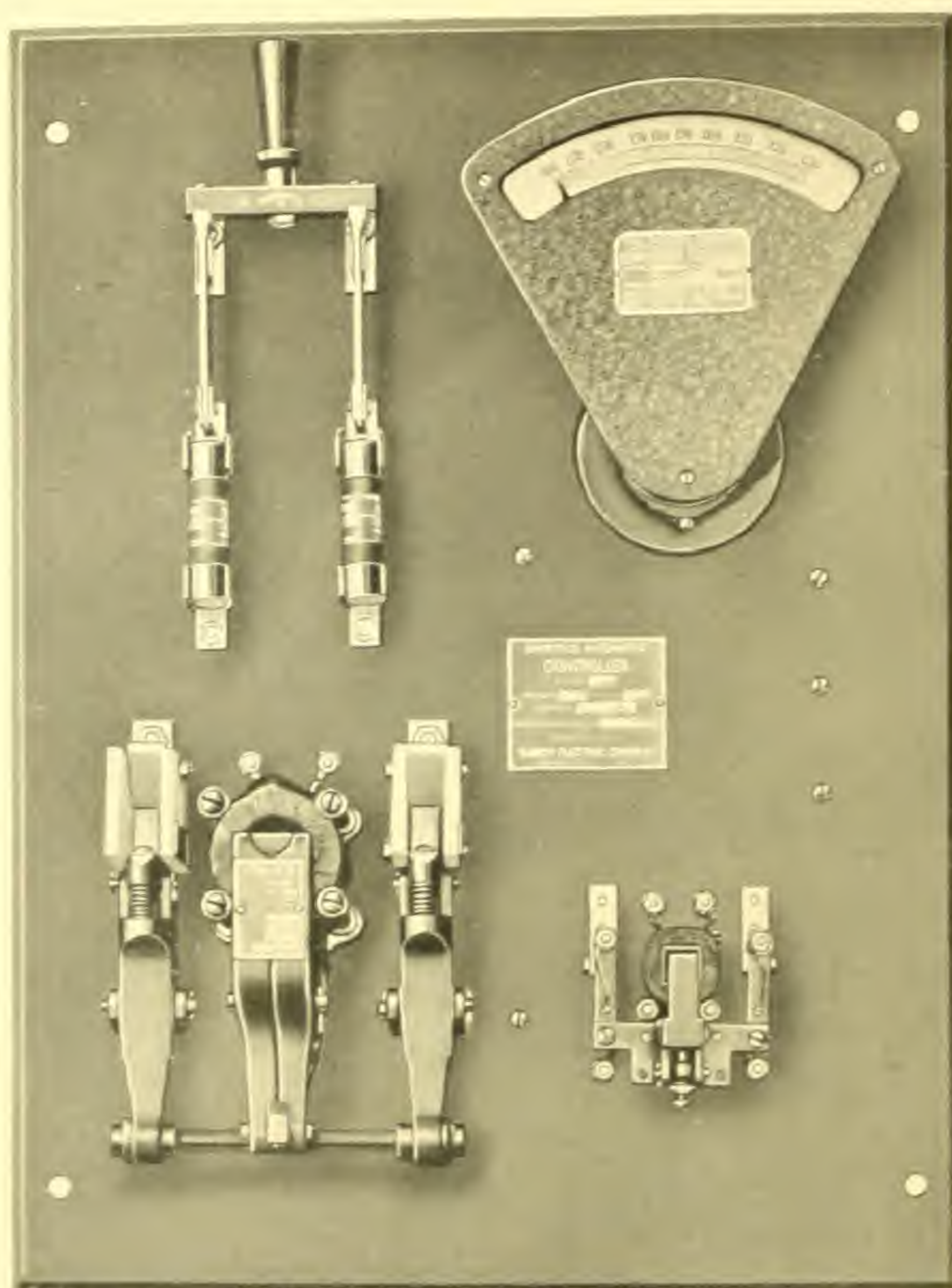
UTILITY

ELECTRICITY

MOTION, ETC.



## AUTOMATIC TEMPERATURE CONTROL



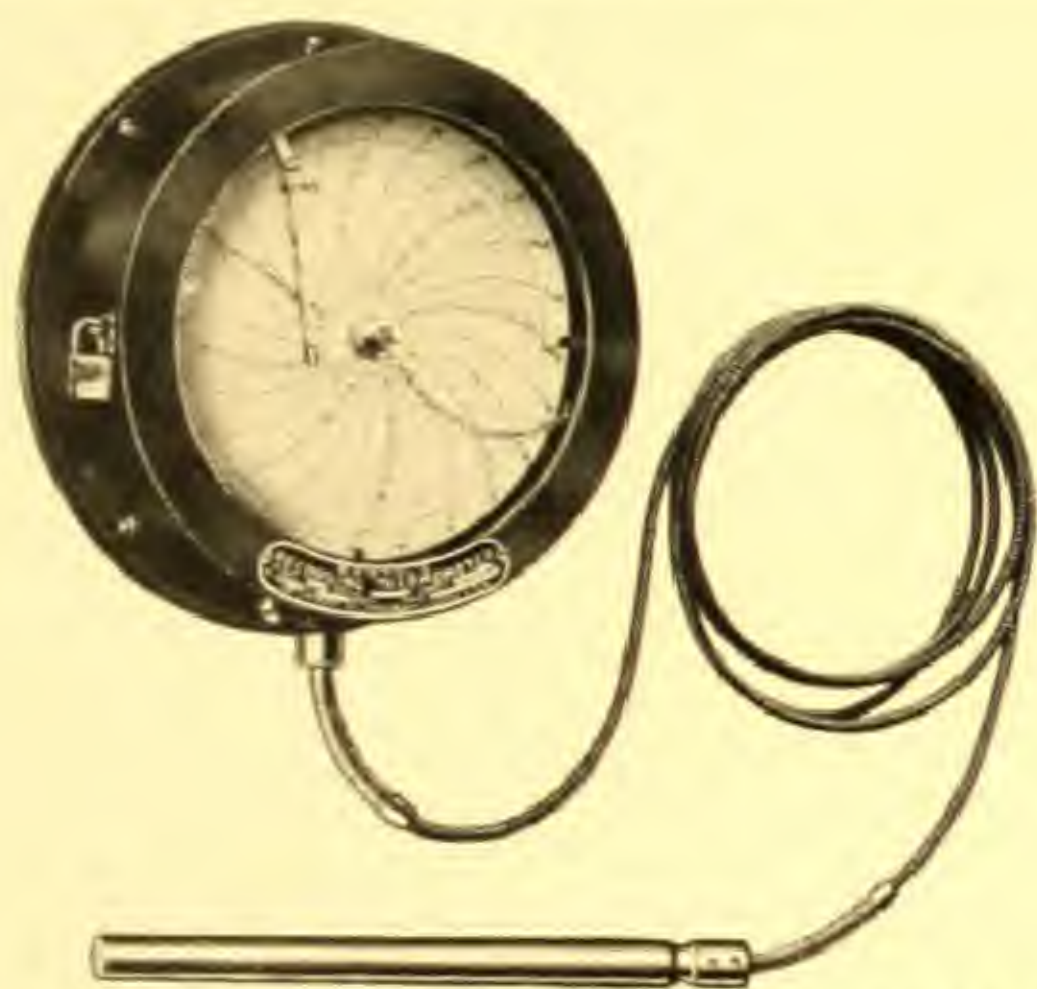
This shows Bristol's Temperature Controller as applied to electric furnaces, complete with switches and relay.



## RECORDING THERMOMETERS

For Atmospheric Temperatures in the room or near the Furnace—Core Ovens—Oil Drawing or Tempering Vat—Preheated Fuel Oil—Temperature of Oil in Storage Tanks—these are some of the places in the Heat Treating Department where Recording Thermometers are used.

Bristol's Recording Thermometers are furnished to record all temperatures up to 1000°F. The several models and various combinations make it possible to furnish a correct instrument for every requirement.



**MODEL 341 BRISTOL'S RECORDING THERMOMETER.** This is the type of recording thermometer used for Core Ovens,

Oil Storage Tanks, etc. A flexible connection between Sensitive Bulb and Instrument makes it possible to locate the instrument in a convenient place for observation, while the bulb is installed inside the oven or tank.

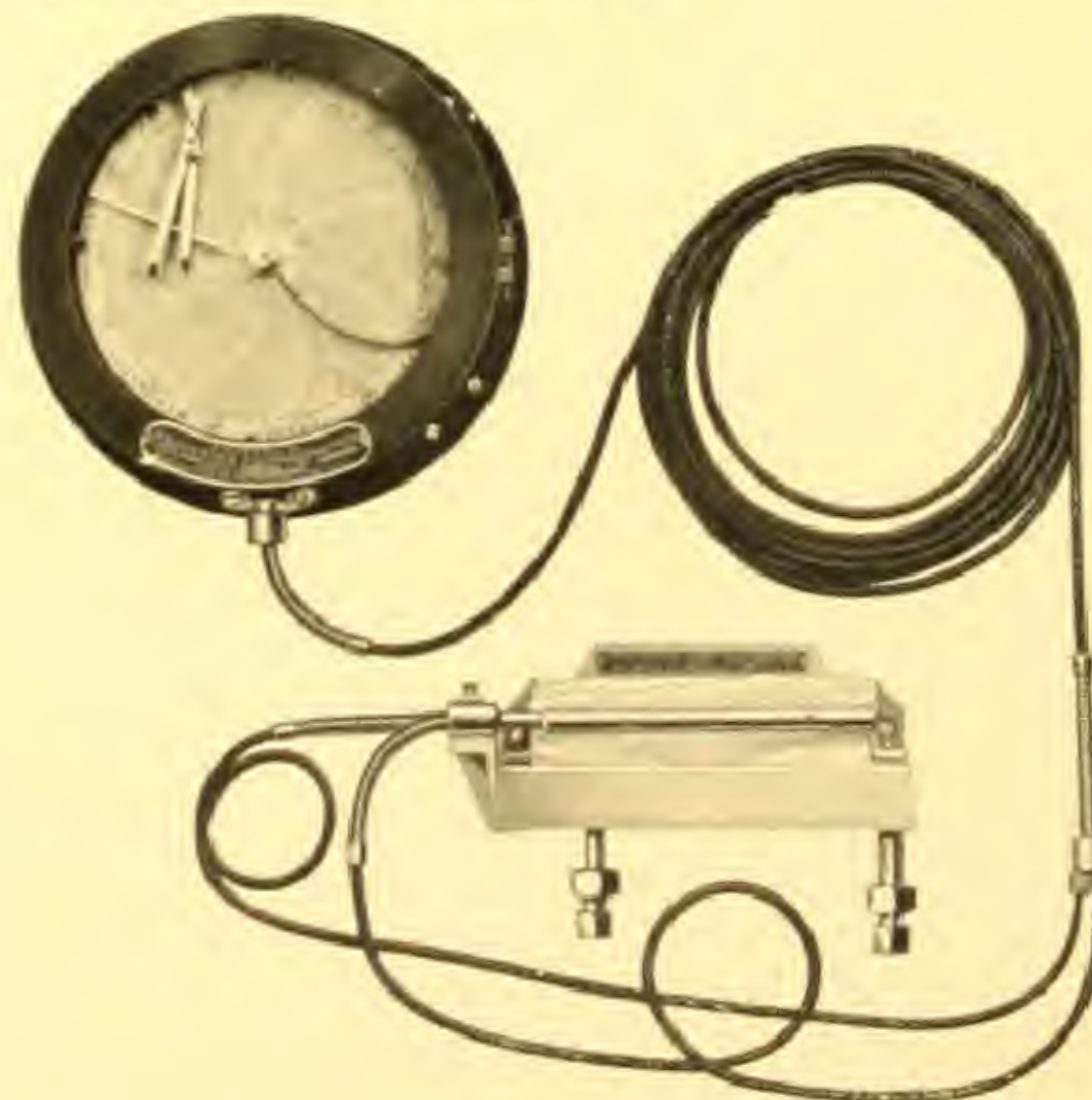


**MODEL 111 SELF-CONTAINED THERMOMETER.** Used for recording atmospheric temperatures. The sensitive bulb is attached directly to the recording instrument, which is installed where temperatures are to be recorded.

## RECORDING PSYCHROMETERS

Sometimes humidifying equipment is used in the rooms, and when it is Bristol's Recording Psychrometer or Wet and Dry Bulb Thermometer gives valuable information to assist in securing desired control. It furnishes a continuous record of relative humidity which is available at all times.

**RECORDING WET AND DRY BULB THERMOMETER MODEL 241,** long distance type, with continuous flow type reservoir. Used for recording all ranges of wet and dry bulb temperatures between 32° and 212°F., from which percent relative humidity can be determined.



ELECTRICITY

MOTION, ETC.



## TACHOMETERS—Indicating and Recording

To operate any machinery efficiently, there is a right speed which should always be maintained. To control this it is necessary to know the speed of motors and other forms of drive, and to furnish such information Bristol's Electric Tachometers are used.

The instruments are available in both indicating and recording models, which may be used separately or in combination.

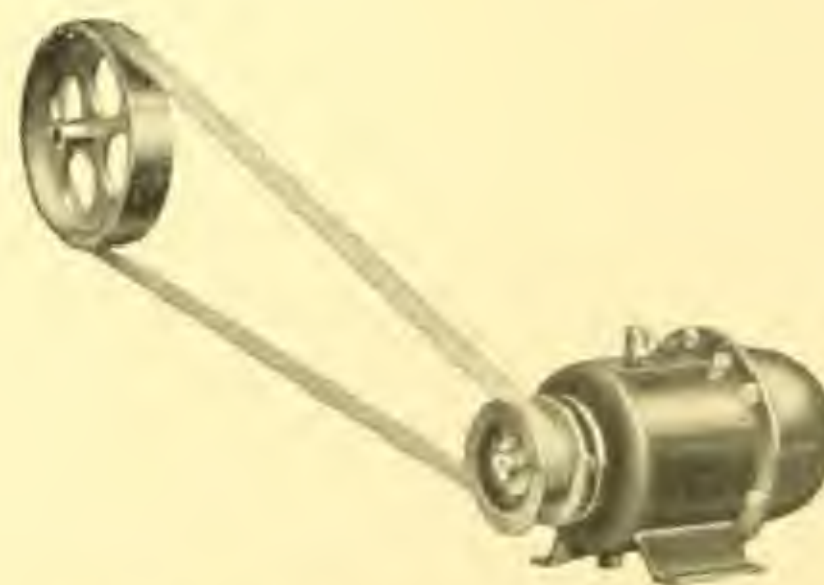
The tachometer equipment includes a magneto, which is driven directly from the pulley, shafting or other source and generates an electrical current. The magneto in turn is connected by flexible copper wires to the instrument which contains a voltmeter. The voltage generated by the magneto is measured at the instrument and read on the dial or recorded on the chart in terms of revolutions. This type of instrument is very sensitive and responds immediately to the slightest change in voltage.



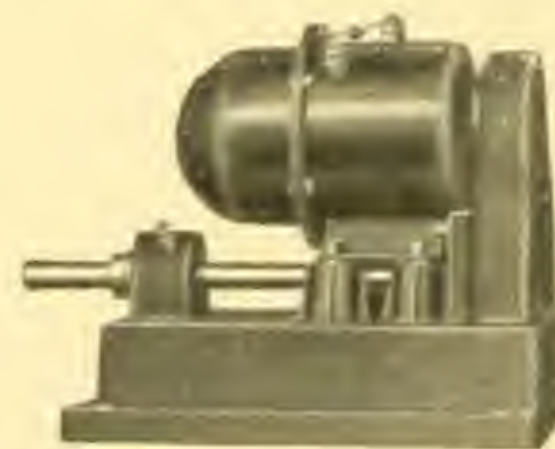
**RECORDING ELECTRIC TACHOMETER, ROUND CHART MODEL 1837.** For all commercial ranges of speed or revolution. When desired, Recording Tachometer of strip chart type can be furnished.



**INDICATING ELECTRIC TACHOMETER, MODEL 18-410.** This indicating instrument may be used separately or in combination with the recorder.



Magneto with pulley for belt drive



Magneto with speeding-up stand



## TACHOMETERS—Indicating and Recording



Magnetometer with silent chain drive



Magnetometer with universal joint for direct drive



Magnetometer on speeding-up stand arranged for silent chain drive



Magnetometer on speeding-up stand and with universal joint drive



Magnetometer with direct gear drive



Magnetometer on speeding-up stand arranged for gear drive

## ELECTRIC OPERATION RECORDER

A glance at the chart record made by Bristol's Electric Operation Recorder shows the length of time a piece of machinery or other equipment is in operation or idle. They are often used to record the opening and closing of valves, gates, doors, traps, draft slides, the operation of cranes, moving machinery, etc.

The instrument is operated by current from lighting circuit or dry batteries. A simple contactor at the point of operation connected with a wire lead to the instrument is all that is necessary to install the equipment. It is a very flexible method and the location of the operation may be almost any distance from the instrument. Furthermore, they may be in several scattered positions as the instrument illustrated can be furnished to record from one to twelve different operations on the one chart; while a strip chart recorder can be supplied to record as many as twenty different operations on the one chart.



**ELECTRIC OPERATION RECORDER MODEL 911.** The instrument shown is equipped with 6-penarms to record six different operations on the one chart. This same instrument can be furnished with any number of penarms up to twelve, while a strip chart instrument can be supplied to make even twenty records on the one chart.

ELECTRICITY

MOTION, ETC.



## RECORDING PRESSURE GAUGES

Used for recording Pressure of Incoming Gas—Gas at the Furnace and ahead of the Burner—Oil Pressure—Steam Pressure used for Vaporizing—Steam Pressure for Pre-heating Oil. Recording Pressure Gauges can be furnished for all pressures up to 12,000 pounds per square inch.



**MODEL 41 RECORDING PRESSURE GAUGE**  
with inverted penarm and moisture-proof case; furnished to use with 10-inch or 8-inch charts

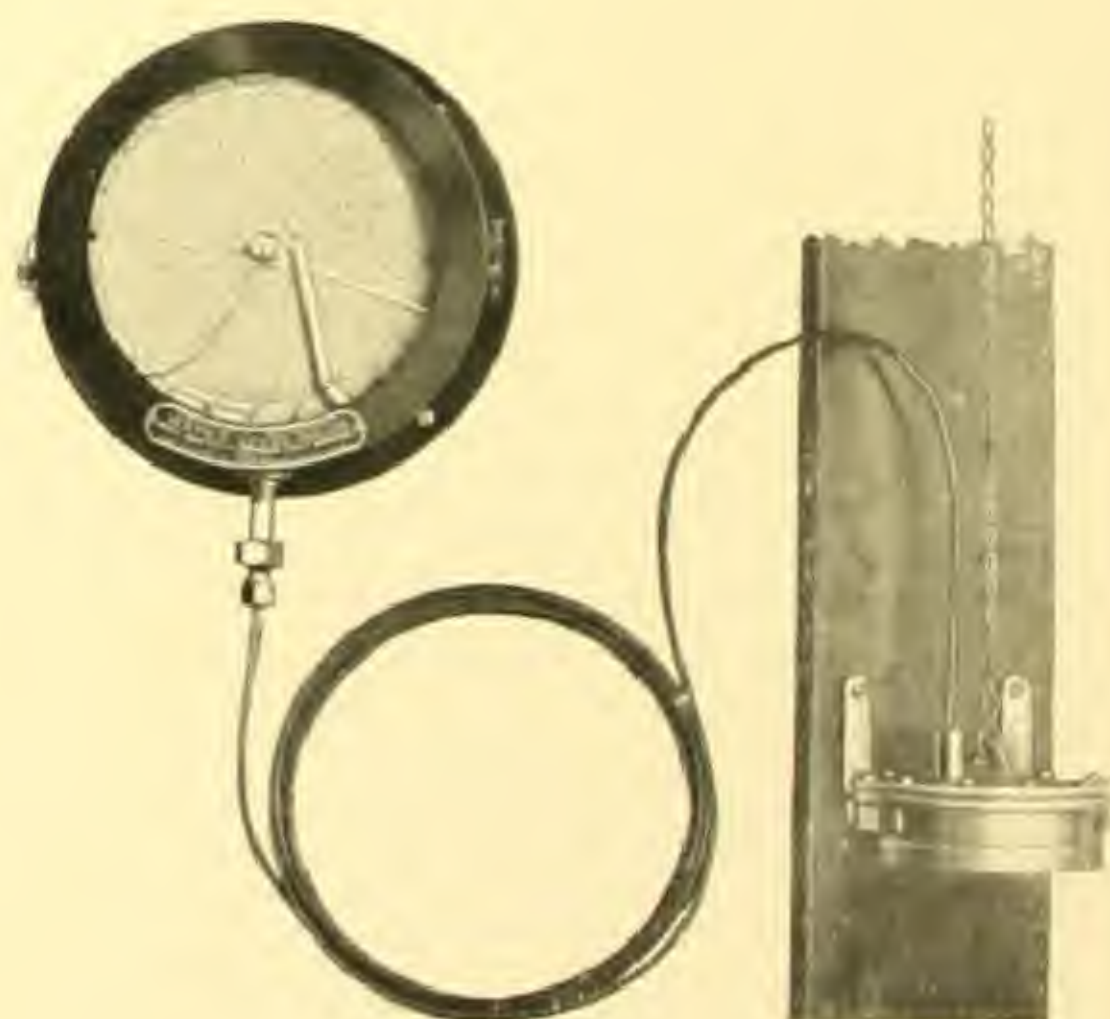


**MODEL 11 RECORDING PRESSURE GAUGE**  
furnished with 12-inch or 8-inch charts

## LIQUID LEVEL GAUGES

A definite and permanent record of the height of oil in the fuel tanks is furnished by Bristol's Recording Liquid Level Gauge shown here. The recording instrument can be placed at any convenient location either above or below the tank, and bendable tubing is used between the instrument and the bulb which is installed in the tank.

**RECORDING LIQUID LEVEL GAUGE MODEL 41.** This round model can be furnished with 10-inch or 8-inch charts. The case is moisture-proof.



RECO  
735. For  
standard  
Potential  
instrumen  
farmers.



## ELECTRICAL RECORDING INSTRUMENTS

To check line voltage, current used by motors and furnaces, and to know the Kilowatt consumption for any period of time, are some of the important uses of Bristol's Electrical Recording Instruments. Electricity is more and more extensively being used in the heat treating department and makes the information furnished by these instruments valuable for securing smooth running and efficient operating conditions.



**RECORDING VOLTMETER MODEL 511.** For all ranges of A.C. and D.C. It is shown furnished in the new improved dust-proof case with smooth black finish to match other similar instruments on the panel-board.



**RECORDING WATTMETER MODEL 735.** For Single or Polyphase Circuit. The standard current windings are 5-amperes and Potential Windings for 100 or 200 volts. The instrument is generally used with transformers.



**RECORDING AMMETER MODEL 647.** The chart used with this instrument is 6-inches in diameter, and may be furnished having increasing or uniform scale graduations. Instruments are calibrated for A.C. or D.C. but for 5 Ampere windings only.

ELECTRICITY

ELECTRICITY

MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE



## THE BRISTOL COMPANY

Main Office and Factory  
WATERBURY, CONN., U. S. A.

<b>BOSTON</b> Old South Bldg.	<b>NEW YORK</b> 114 Liberty St.	<b>BRANCH OFFICES:</b> <b>PHILADELPHIA</b> Widener Bldg.	<b>BIRMINGHAM</b> Age-Herald Bldg.	<b>PITTSBURGH</b> Frick Bldg.
<b>DETROIT</b> Book Bldg.	<b>CHICAGO</b> Monadnock Block	<b>ST. LOUIS</b> Boatmen's Bank Bldg.	<b>SAN FRANCISCO</b> Rialto Bldg.	

### THE MOST EXTENSIVE LINE OF RECORDING INSTRUMENTS IN THE WORLD

#### PRESSURE AND VACUUM

Bristol's Recording Pressure and Vacuum Gauges

#### LIQUID LEVEL

Bristol's Recording Water Level Gauges

#### TEMPERATURE

Bristol's Class I Recording Thermometers

Bristol's Class II Recording Thermometers

Bristol's Class III Recording Thermometers

Wm. H. Bristol Indicating and Recording Electric Pyrometers

Bristol's Temperature Controllers

#### HUMIDITY

Recording Wet and Dry Bulb Thermometers

#### ELECTRICITY

Bristol's Recording Voltmeters

Bristol's Recording Ammeters

Bristol's Recording Wattmeters

Wm. H. Bristol Recording Milli Voltmeters

Wm. H. Bristol Recording Shunt Ammeters

Bristol's Recording Frequency Meter

#### TIME

Bristol's Electric Time Recorders

Bristol's Mechanical Time Recorders

#### SPEED

Bristol's Recording Tachometers

#### MISCELLANEOUS

Supplies for Bristol Recording Instruments

Bristol-Durand Radii Averaging Instruments

Gaugeboard Clocks

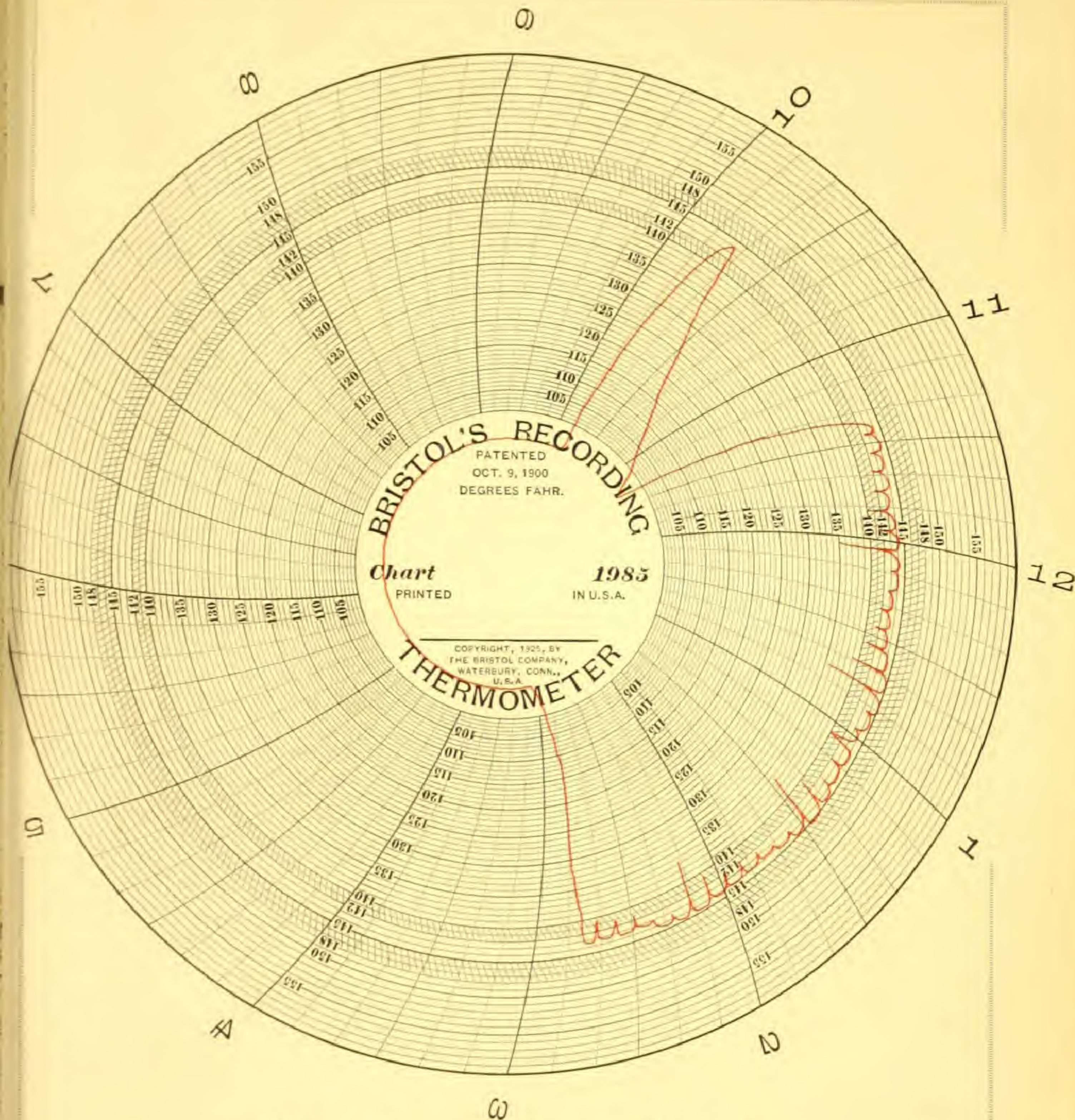
Bristol Engine Counters

Bristol Revolution Counters

Bristol Patent Safety Set Screws

**Bristol's Patent Steel Belt Lacing—The Perfect Fastener for All Kinds of Belts**





## IDEAL PASTEURIZER CHART

Much study has been given to the requirements for a recording thermometer chart best suited to pasteurizing work. The result is Bristol's No. 1985 Chart shown above.

This chart has a range of 100°F. to 160°F. with 1° scale graduations throughout. The scale is also increasing so that the pasteurizing temper-

atures come in the more open portion where it is easy to read. Zone markings are provided at 142°F. and 145°F. which are the high and low temperature limits for pasteurizing. These markings make it easy to detect any radical variation in the record. As a further aid to open record, the chart is arranged for one revolution in 12 hours.

ELECTRICITY

MOTION, ETC.



## SANITARY (THERMOMETER) VAT FITTING



Fig. 2526

This fitting is the one approved by the Standardization Committee of I. A. M. D. and now regularly furnished with Bristol's Recording Thermometers when required for use on pasteurizing vats.

Instead of the previous multiplicity of fittings, there is now only the one, because it has been adopted for use by such builders of vats as Cherry, Creamery Package,

Cream Product, Manning, Reid Batch and Wisner.

This coming together in a common understanding is a very progressive step and greatly simplifies the installation of recording thermometers.

The use of this patented fitting by The Bristol Company is authorized, and those buying are not liable to patent litigation.

## IMPROVED BRISTOL'S BULB

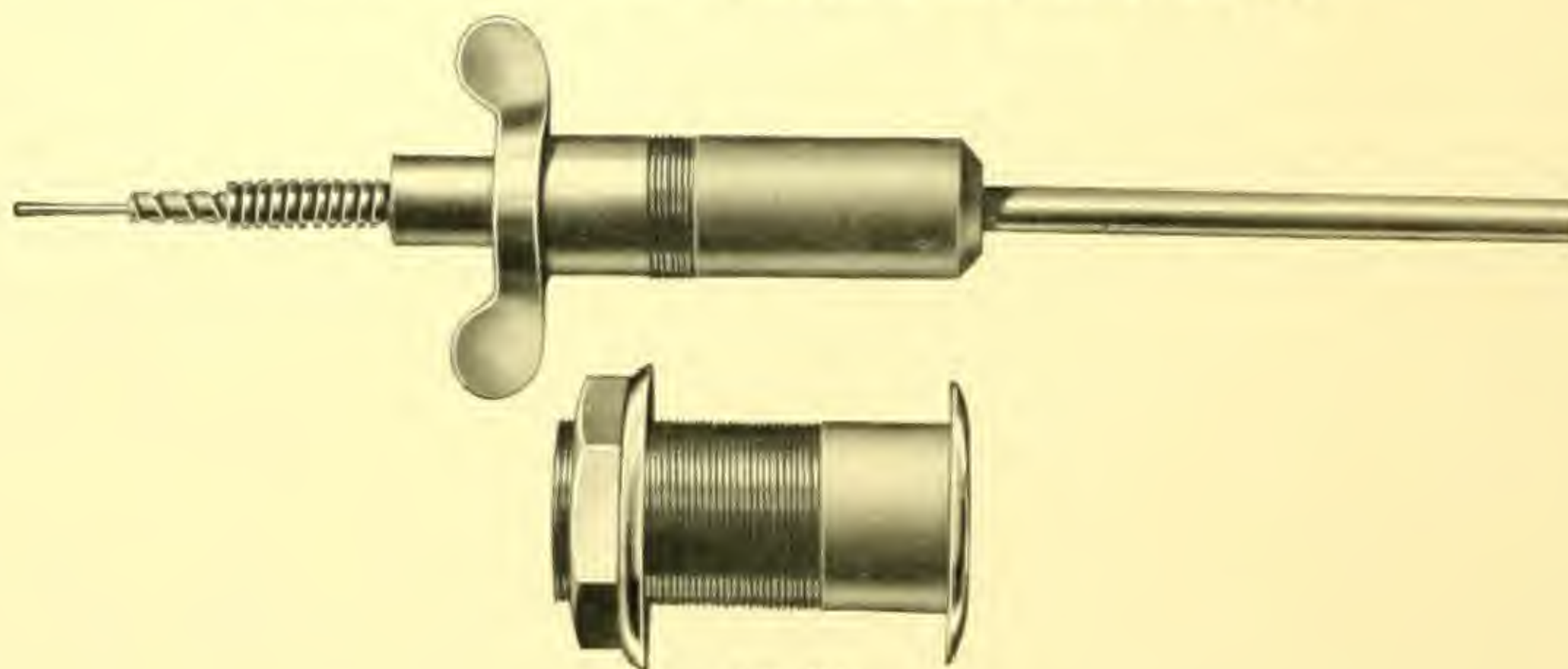


Fig. 2527

This bulb is specially designed for installing in connection with pasteurizing vats, and particularly with the Sanitary Fitting also shown on this page.

In developing this bulb, the idea of making it absolutely sanitary has been kept in mind. To do this, all cracks and crevices for the possible accumulation of milk have been eliminated, and even the seat is cut to knife-edge on the inside, as may be seen in the illustration. Also to prevent any possible action of lactic acid, all exposed parts of the bulb are covered with hot tin plate,

and those parts which are frequently handled or in view from outside are highly polished nickel.

Another feature of this bulb is the fact that it may be used with either the new standard vat fitting, also on vats already equipped with the old style fitting; so that if it is desired to equip old style vats with the new bulb this can be done without making other changes.

In regard to projection of the bulb into the vat, it can be furnished in lengths suitable to individual conditions.



## SEALED EXTERNAL ADJUSTER

The correctness of the pasteurizing process depends almost entirely on the recording thermometer. For this reason it is well to occasionally check the instruments in regard to accuracy.

To provide an easy adjustment for errors of a few degrees in reading, Bristol's Recording Thermometer may be furnished equipped with sealed external adjuster, as shown in the illustration.

With this device the complete adjustment is made on outside of case and sealed. Thus it is not necessary to in any way touch the internal working parts and prevents tampering by unauthorized persons.

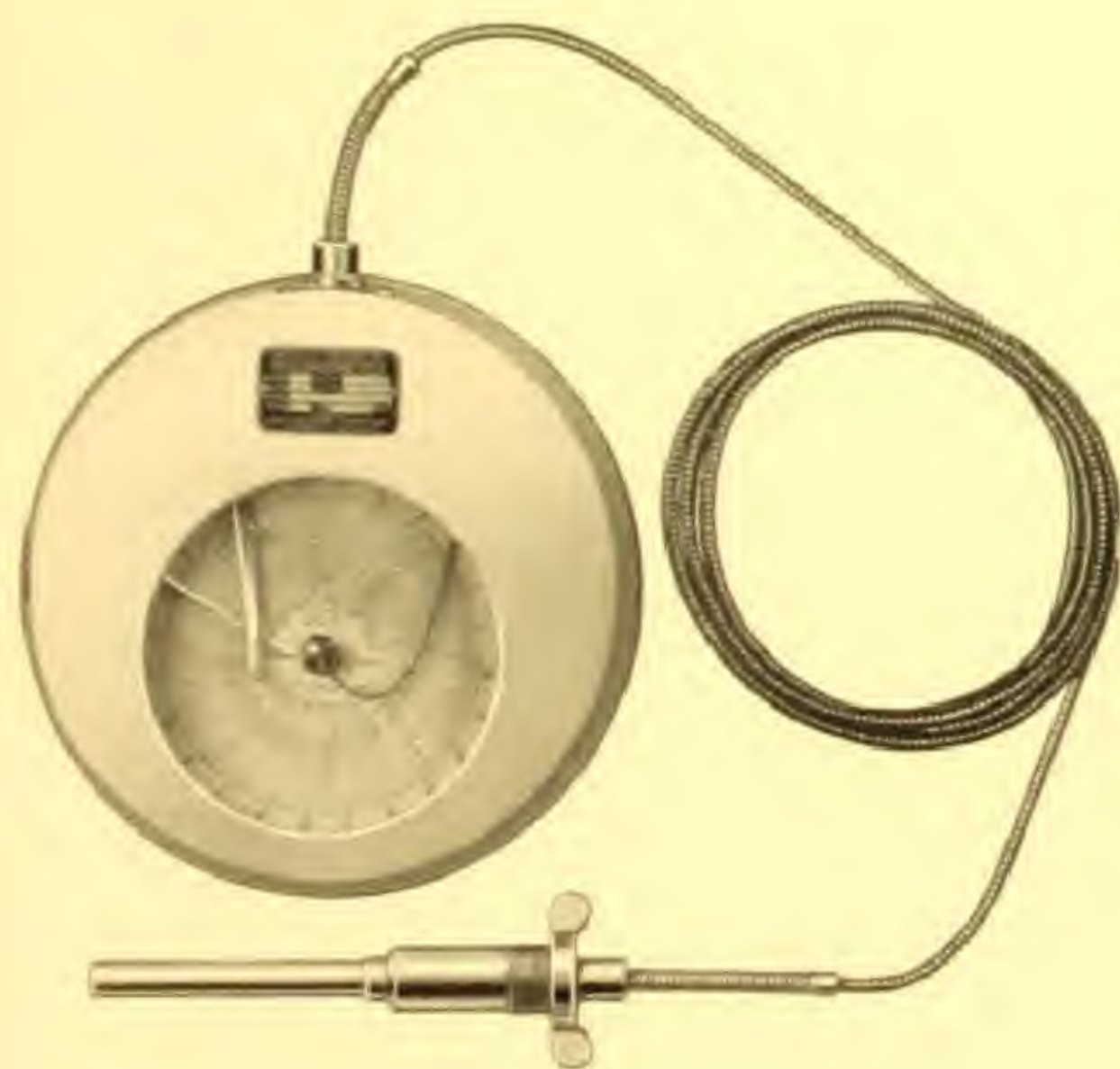
RECORDING THERMOMETER  
WITH 6-INCH CHART

Fig. 2604

This thermometer using 6-inch chart, is suitable for use where very close readings are not required, and the expense of a larger instrument is not justified. It is, however, in design and workmanship equal in every way to other Bristol's Models, and can be furnished equipped with same fittings. The case is dust and moisture-proof.

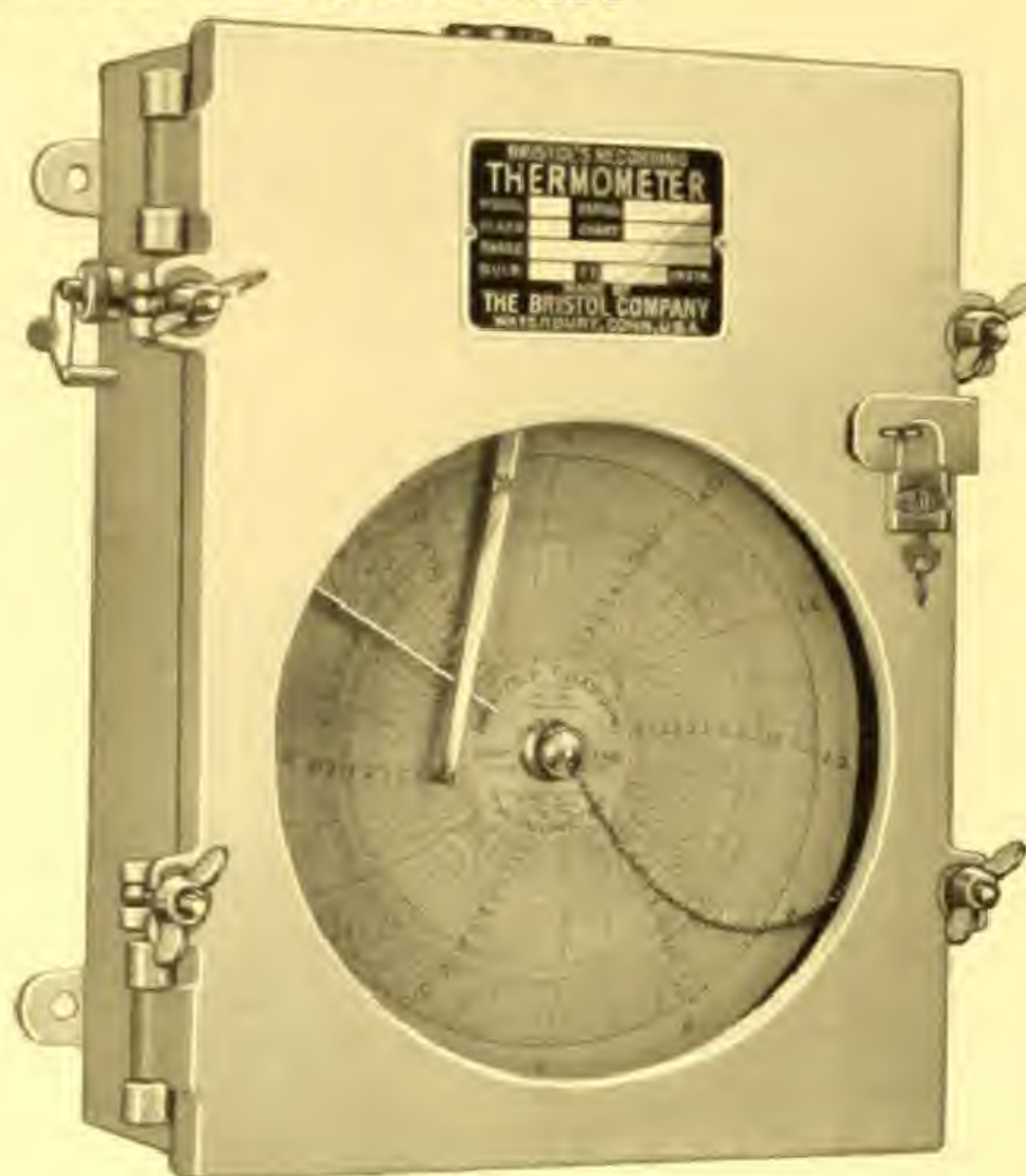


Fig. 2602

ROUND FORM MODEL  
BRISTOL'S RECORDING THERMOMETER

Fig. 2609

This recording thermometer can be furnished to use 10-inch or 8-inch charts. The case is moisture-proof and thoroughly protects the working parts.

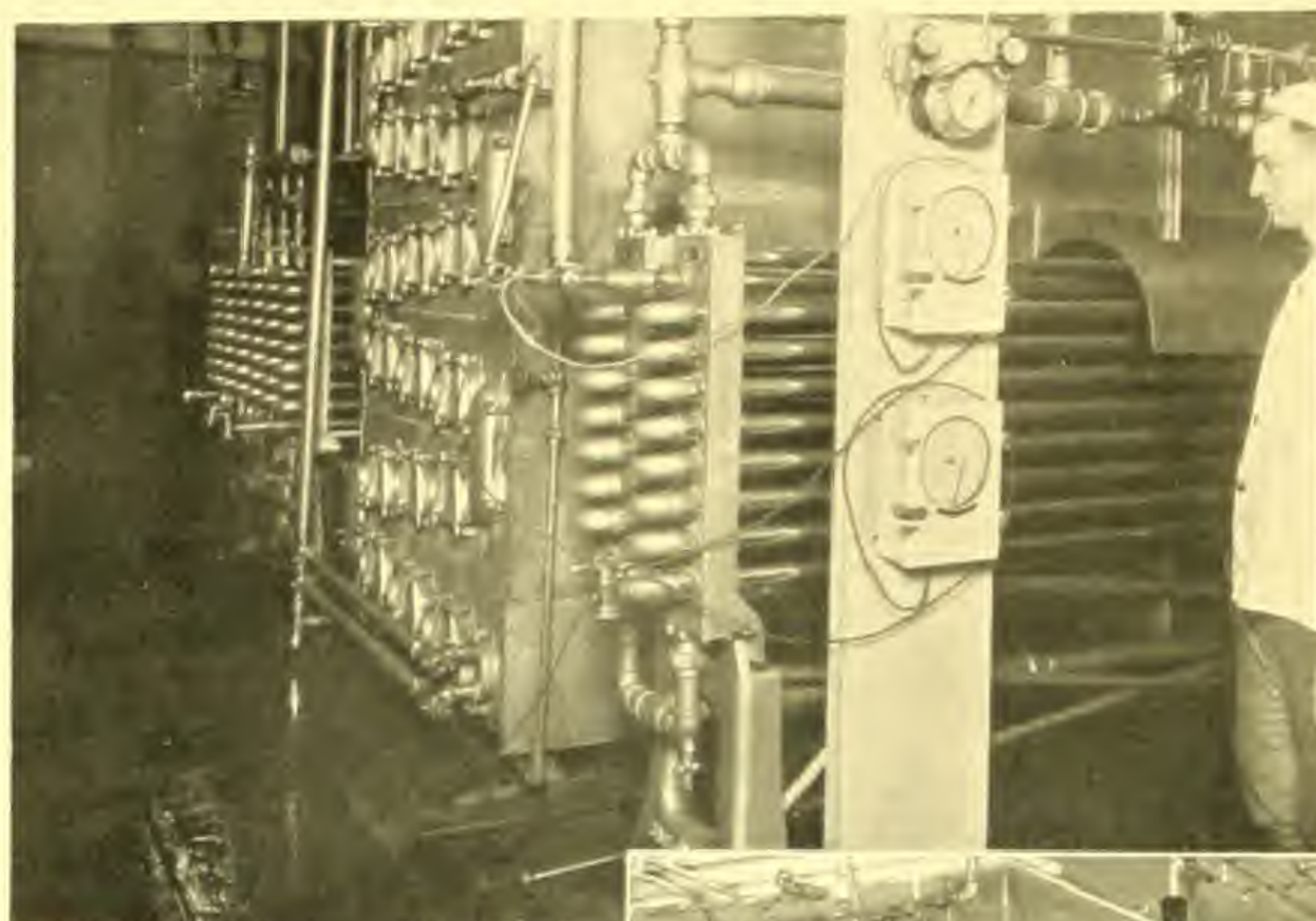
The bulb shown is connected directly to instrument for installing through top of pasteurizer. Any other type of bulb and fitting can be furnished as required.

ELECTRICITY

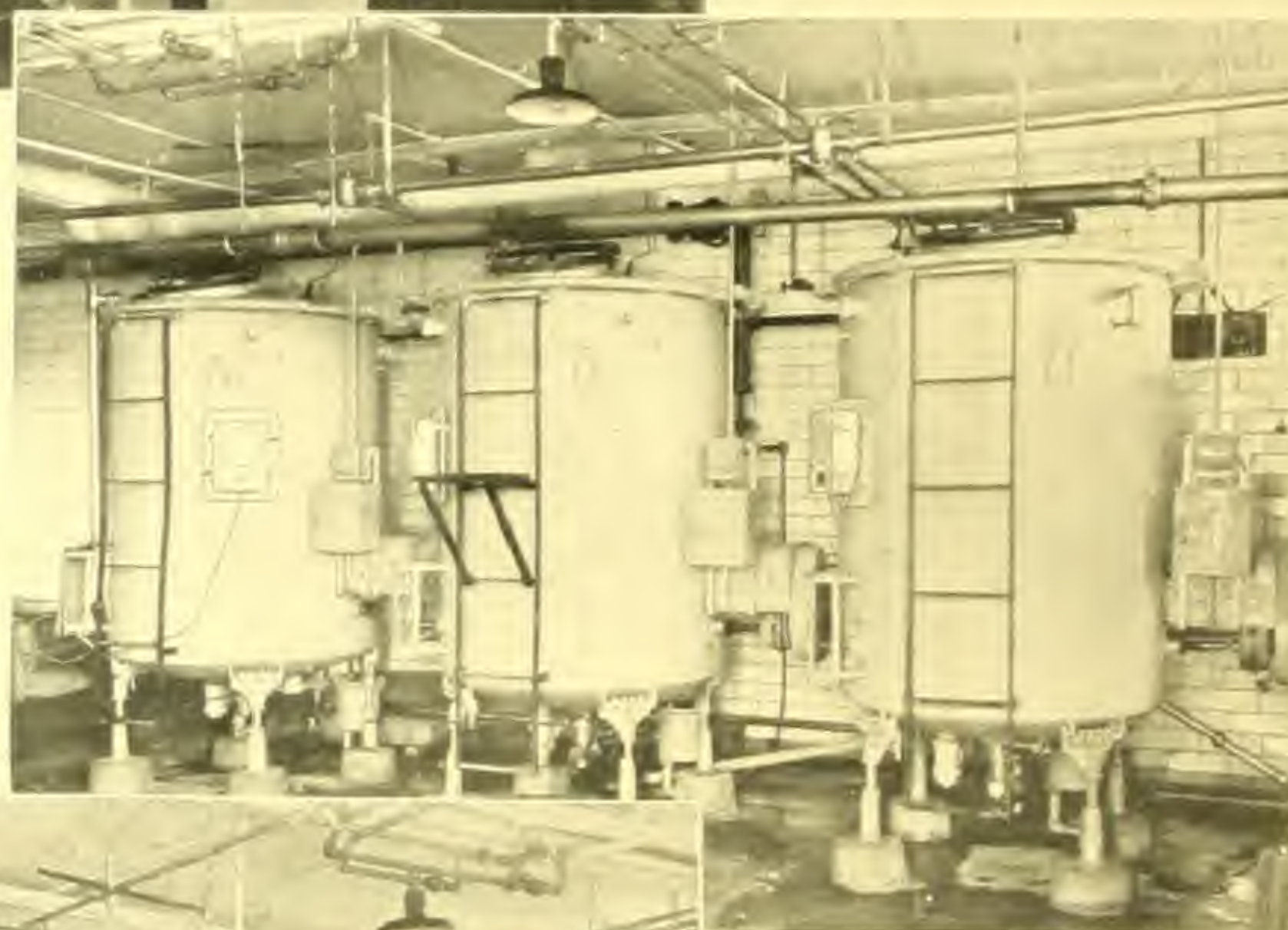
MOTION, ETC.



TRADE MARK  
**BRISTOL'S**  
 REG. U.S. PAT. OFFICE



*Bristol's Recording  
 Thermometer in the  
 City of Chicago on  
 Simplex Pasteurizer*



*Bristol's Recording  
 Thermometers in the  
 City of Milwaukee on  
 Pfaufler Tanks*



*Bristol's Recording  
 Thermometers in the  
 City of Milwaukee on  
 Pfaufler Tanks*

The Bristol Company Waterbury, Connecticut





HUMIDITY

ELECTRICITY

MOTION, ETC.







TRADE MARK

**BRISTOL'S**

REG. U.S. PAT. OFFICE.

RECORDING ELECTRICAL INSTRUMENTS

Voltmeters

Ammeters

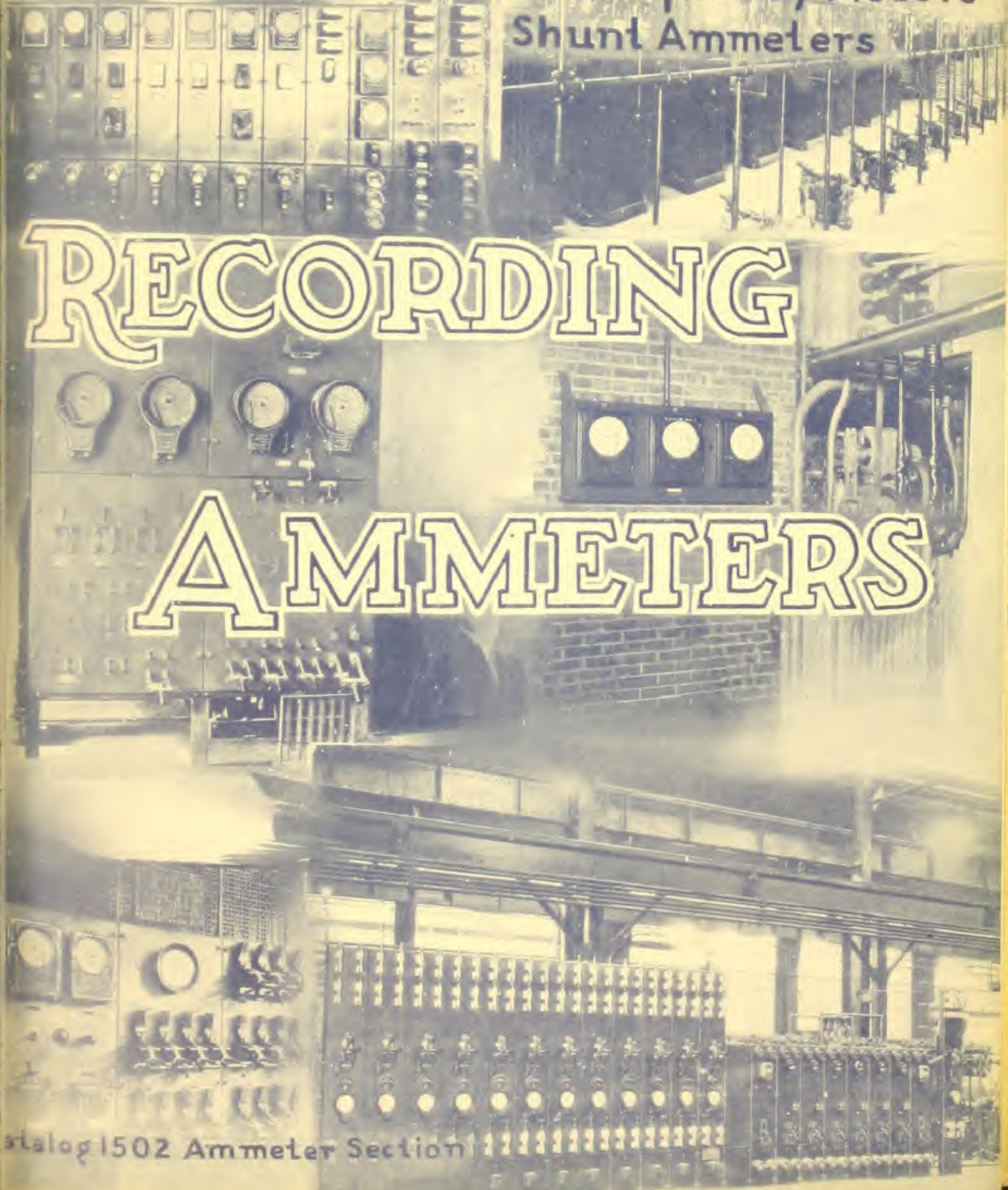
Wattmeters

Millivoltmeters

Frequency Meters

Shunt Ammeters

# RECORDING AMMETERS



1001111

MOTION, ETC.

Catalog 1502 Ammeter Section



**H**OW much current—is a question often heard in connection with Power and Lighting Circuits. Sub-station Buses, Transformers, Grounded Neutral, Motors, Electric Furnaces and Ovens, Electric Signs, etc.

A complete story of current conditions is made with Bristol's Recording Ammeters. A continuous record together with the time, including initial inrush and operating current under variable load conditions.

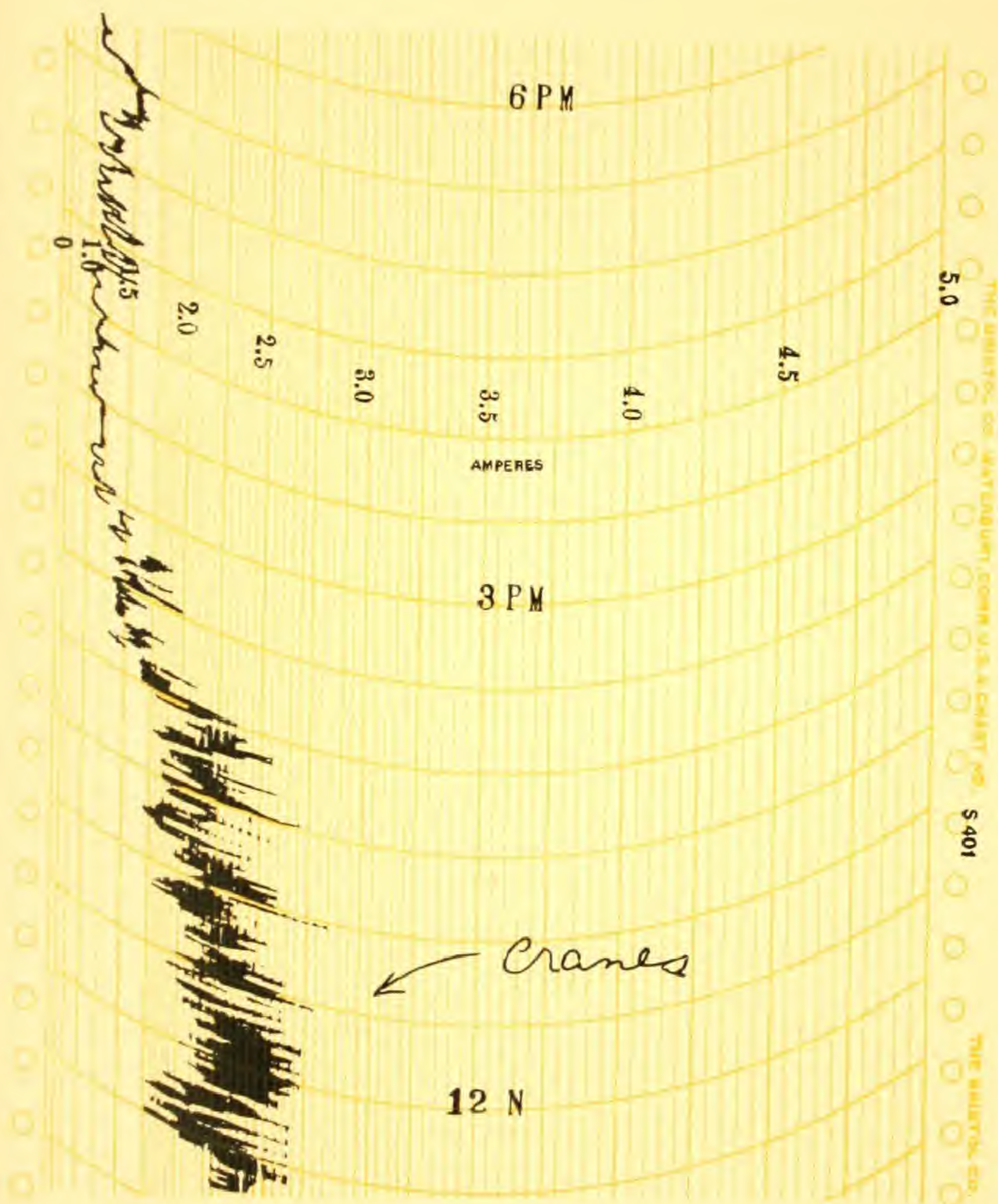
Not only the usual requirements expected of recording ammeters, but Bristol's are also used for many special individual applications, such as Shears and Rollers in the steel plant, Beaters and Jordans in the paper mill, Crushing Rollers in chemical plants, etc., where they furnish much valuable information in regard to operating conditions.

As an example of the kind of data these records furnish, is illustrated by the Recording Ammeter connected in series with motor driving crusher rollers in ink making plant. The ammeter records the load of the individual motor at all times, and shows the superintendent:

- (a) The exact running time of the crushers, especially at night when he is not around.
- (b) Gives actual and definite data on the cost production of various grades of ink. In fact, before the ammeters were installed it was very vague as how to figure in the cost of power.
- (c) Shows at all times the amount of pressure on adjusting rollers. The closer the adjustment the greater amount of power drawn from the motor. For different materials crushed there is a definite adjustment of the rollers.
- (d) Bristol's Instruments proved their value when a new type of machine was purchased from a manufacturer who advised that a 10 h. p. motor would operate satisfactorily, but the Recording Ammeter was connected in with the motor, and showed that the h. p. required was actually 16.

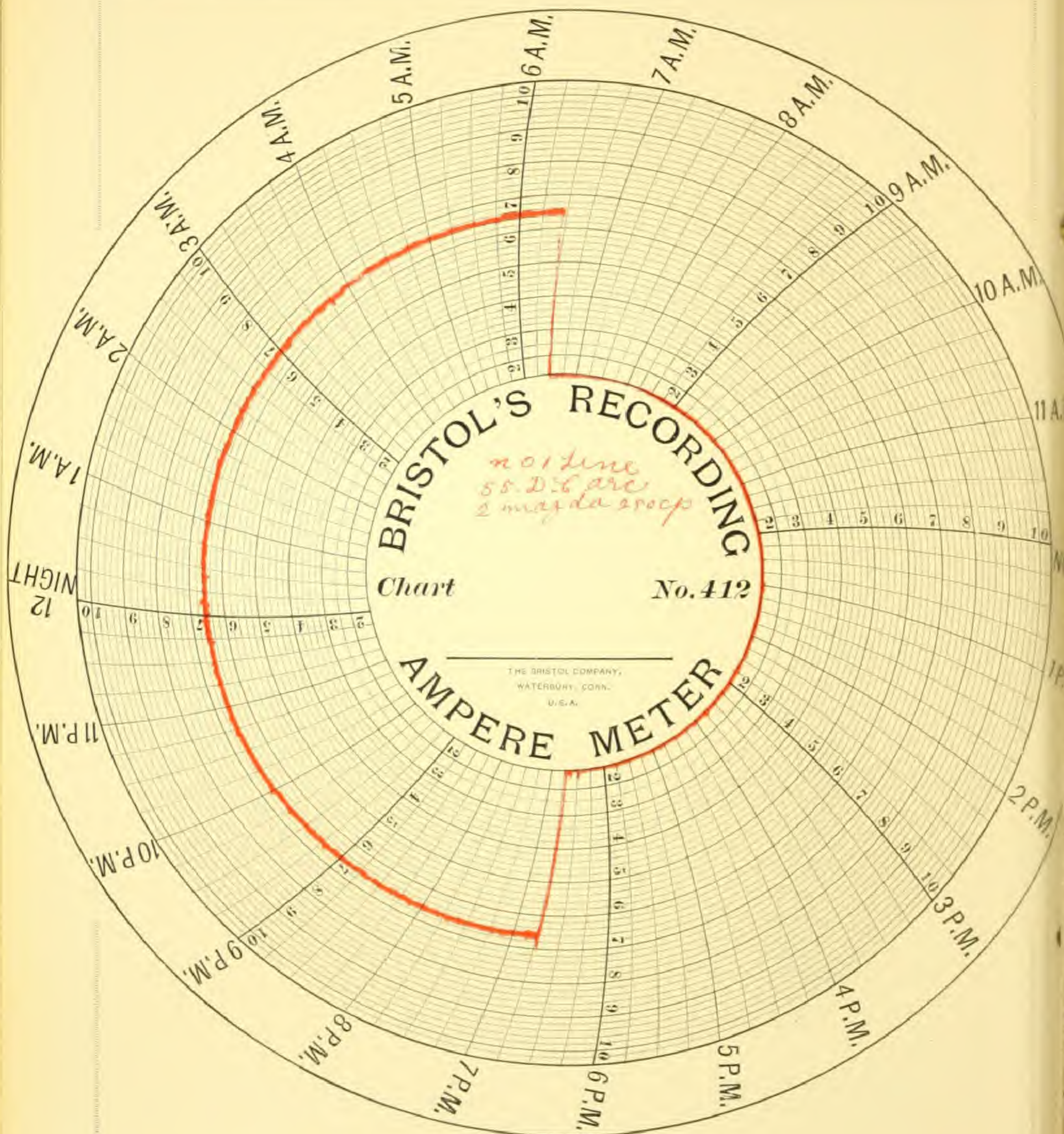
This is just one instance of many where Bristol's Recording Ammeters are serving.





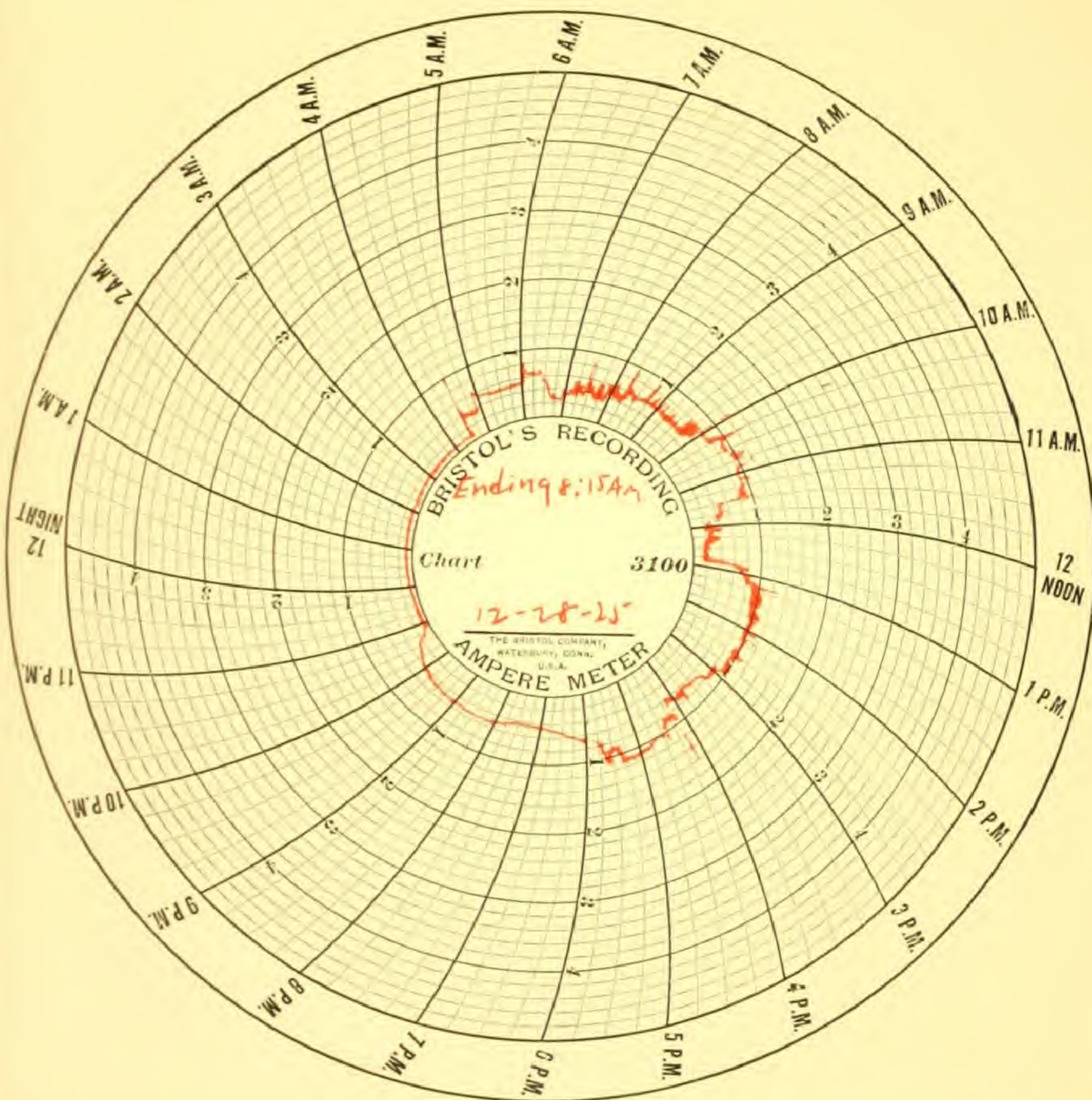
Small portion of Strip Ammeter Chart with record; the complete chart is 90-feet long. This particular instrument is installed in large ice plant and record shows the electric load on a crane.





8-INCH ROUND CHART with RECORD  
Made by "Direct Marking Ink Method"

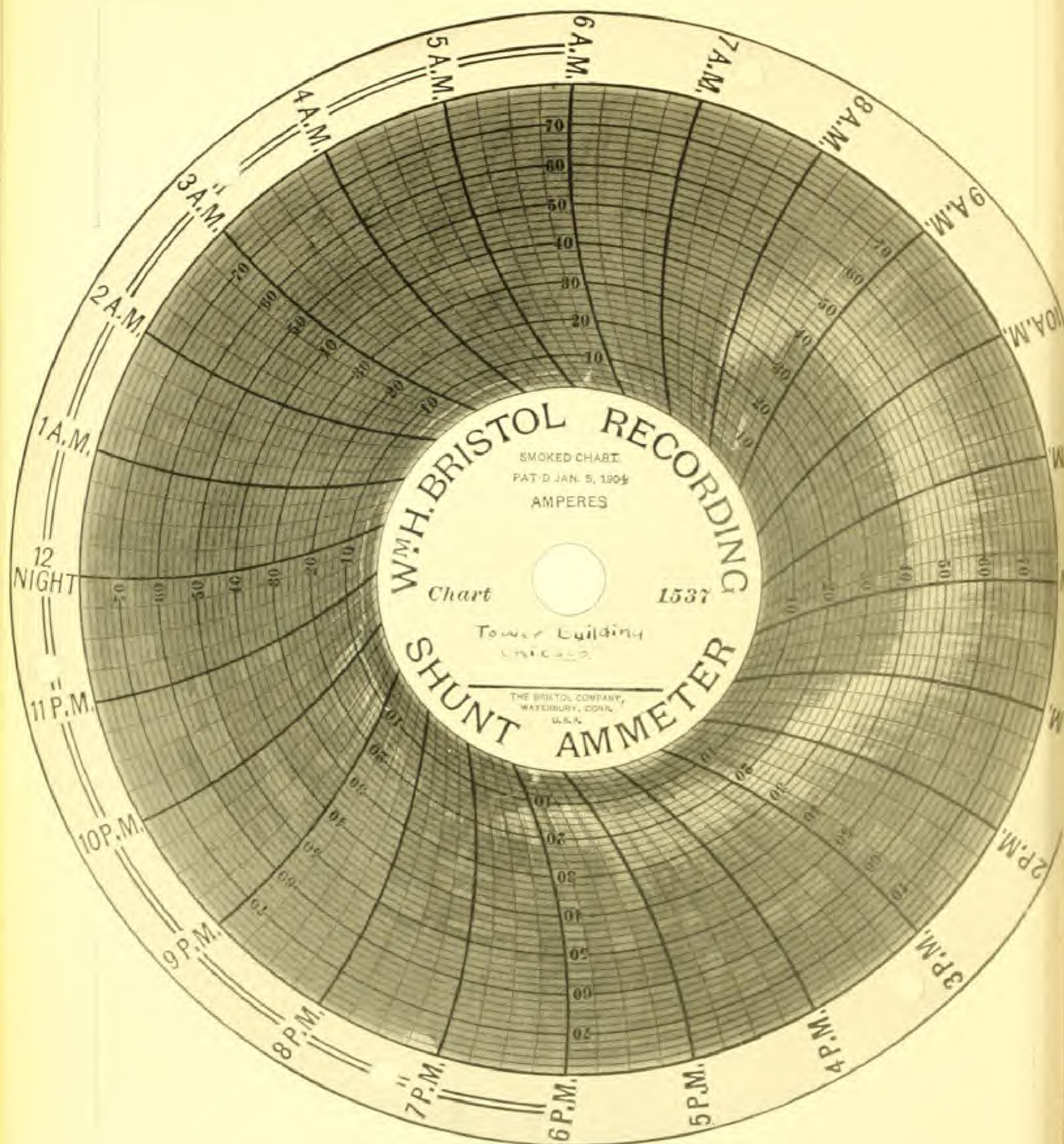




6-INCH ROUND CHART with RECORD

This is full size reproduction of chart used on Bristol's Recording Ammeter Models 647 and 616.  
"Direct Marking Ink Method" of recording is used.





8-INCH CARBON COATED CHART with RECORD  
Notwithstanding the very rapid fluctuations the record line is clearly defined.



## METHODS OF RECORDING

The method of making the record on the chart is a feature of importance in adapting the recording instrument to the work in hand. On previous pages are shown reproductions of charts with actual records, which illustrate several ways available for recording with Bristol's Recording Ammeters and Shunt Ammeters.

"Direct Marking" is the term applied to the method of recording having the penarm in constant contact with the chart. This may be used for ink recording on round and strip charts, also with carbon coated round charts.

With the Bristol types of ammeter movement the "Direct Marking Ink Recording System" is the one in most general use. The pen point rests lightly against the surface of the paper chart and, capillary attraction causes the ink to flow, with the resulting unbroken record, as illustrated on pages 4 and 5.

Where current fluctuations are unusually rapid, best results are obtained with the carbon coated chart system of recording. For direct marking there is no change in the instrument equipment; the carbon coated chart is simply substituted in place of the plain chart. In operation the penarm removes the surface coating leaving a white record line similar to that shown on opposite page. Because the coated surface is not affected by extremes in temperature, this method is especially adapted for out-of-door installations, and is employed on many portable instruments.

On round chart instruments having electrical movements which are not equipped with direct marking penarm, the carbon coated chart is used. The periodically vibrated penarm comes in momentary contact with the surface of the chart and leaves a white dot. The record is a series of dots or practically a continuous line. The chart on opposite page is an illustration of this.

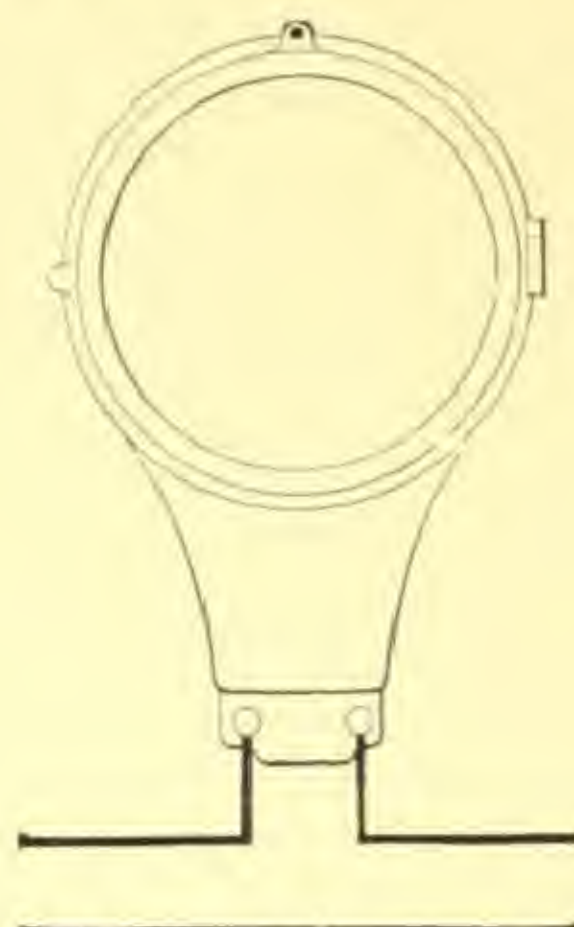
Strip chart instruments not using the direct marking system, a record ribbon similar to that used on typewriters makes the record on the chart as the penarm is periodically pressed against it.

These systems are explained further in connection with the individual movements and various models of instruments covered in this catalog.



## CONNECTING AMMETER IN THE LINE

It is an easy matter to install and connect Bristol's Recording Ammeters. With the complete instructions furnished with each instrument, this can be done by anyone having electrical knowledge.



Method of connecting direct or alternating current circuits.



Method of connecting with series transformer for alternating current circuits.

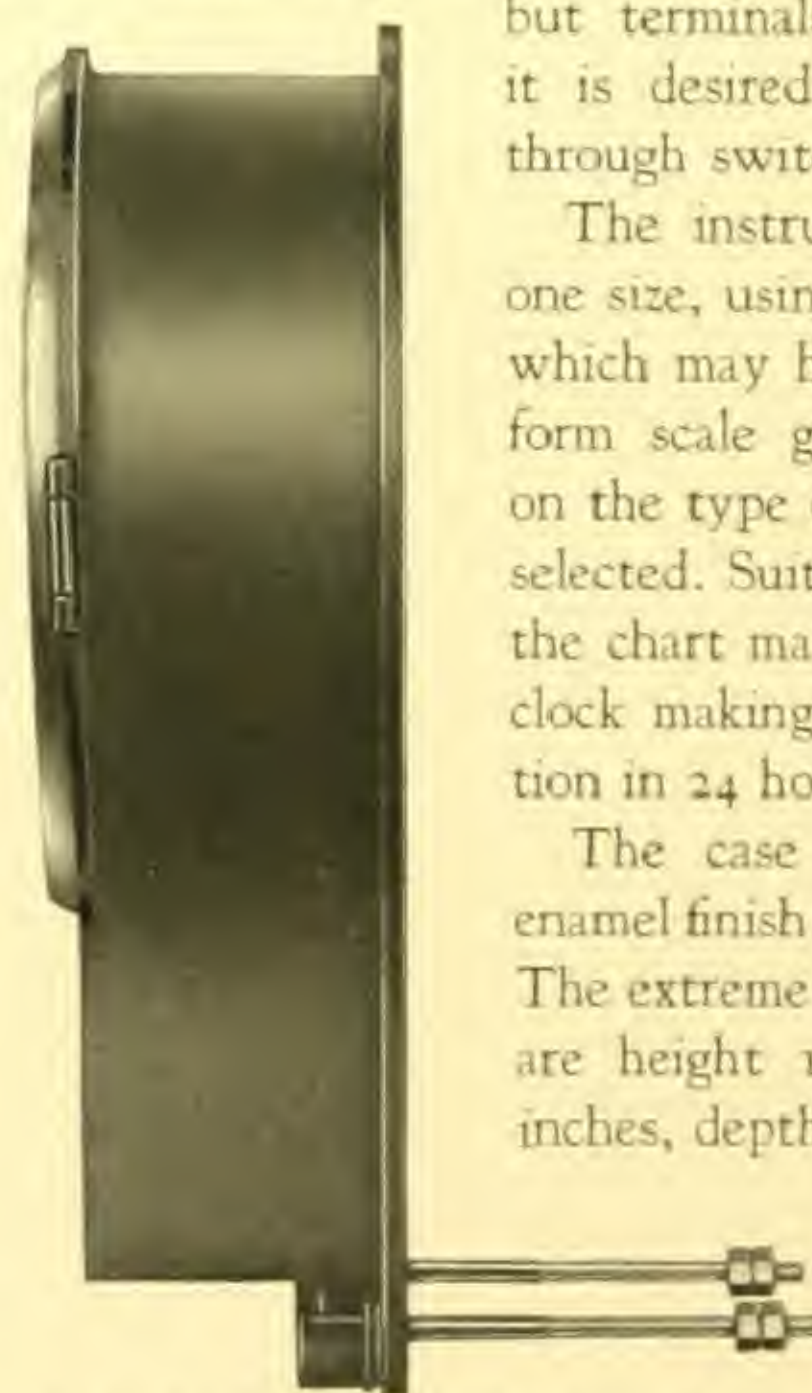
## RECORDING AMMETER MODEL 610

This Recording Ammeter is intended for permanent mounting on wall, switchboard, or

other suitable support. Binding posts on the bottom of case are furnished for front connection, but terminals on the back when it is desired to make connection through switchboard panel.



Equipped with Binding Posts for Front Connection.



Side View of Model 610 showing Terminals for Back Connection.

The instrument is furnished in one size, using 8-inch round charts, which may have increasing or uniform scale graduations, depending on the type of electrical movement selected. Suitable time divisions on the chart may be had for use with clock making one complete revolution in 24 hours or 7 days.

The case is metal with black enamel finish and nickel raised parts. The extreme dimensions of the case are height 15 1/8 inches, width 10 inches, depth 3 1/2 inches.





## RECORDING AMMETER MODEL 635

The rectangular case provides ample room for the Law of Squares movement, which because of its width is not possible to mount in Models 610 and 647. However, this rectangular model is not limited in use to the Law of Squares movement, but any other type of Bristol's Ammeter Movement can be furnished in it when desired.

Made in one size for 8-inch round charts.

When furnished for front connection, the binding posts are inside the case with bushed holes in the bottom through which the leads pass. It may also be furnished with terminals on back for mounting through switchboard panel.

The case is all metal finished in black enamel with nickel raised parts. Extreme dimensions of case are height 16 inches, width 11 1/2 inches, depth 4 3/8 inches.

## RECORDING AMMETER MOISTURE-PROOF MODEL 640

When Bristol's Ammeters are to be used out-of-doors, they are furnished in this iron, moisture-proof case which protects the movement from weather conditions.

To make alignment easy, especially when mounting on pole, adjustable lugs are provided on back of case.

The handle which may be furnished on top of case affords a convenience in handling the instrument. This particularly applies when instrument is not permanently installed, but frequently moved from place to place for test work.

Like other rectangular models this case allows sufficient room to mount any of the electrical movements offered. Thus the instrument is not

limited in any way to a selection of suitable equipment for the work.



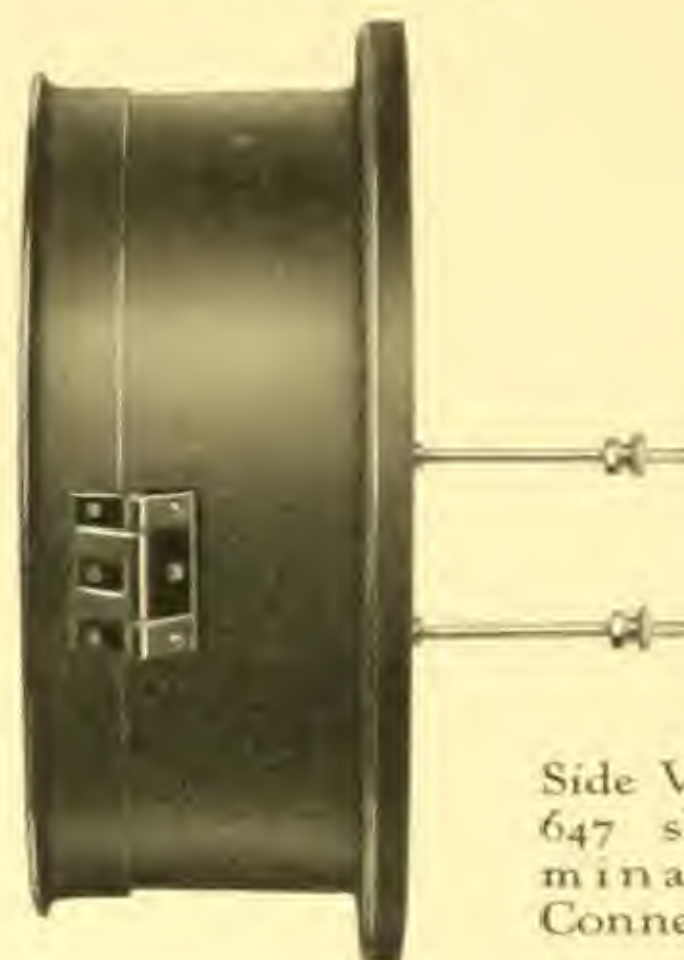
Illustration shows adjustable lugs on back of case, particularly convenient for mounting on pole.

Handle can be furnished on top of case which makes this a semi-portable instrument and greatly facilitates handling.



**RECORDING AMMETER MODEL 647**

Equipped with Binding Posts for Front Connection.



Side View of Model 647 showing Terminals for Back Connection.

This Recording Ammeter is furnished with 6-inch charts only. When relative values rather than wide open readings are important, this small instrument is in every way a satisfactory equipment. The same high quality of electrical movement is used as in the other Bristol Ammeters.

Like other round chart ammeters, this model can be furnished with clock to make one complete revolution of chart in 24 hours or 7 days.

The all metal case of aluminum is finished in black enamel. It is moisture-proof and dust-proof, thus giving complete protection to the working parts.

Extreme outside dimensions of case are diameter 11 3/8 inches, depth 4 1/8 inches.

**RECORDING AMMETER PORTABLE MODEL 612**

For electric service companies this portable recording ammeter is especially useful. Mounted in the wooden case it is light in weight and, thus easily carried about to obtain records of current



wherever required, on the line, the customers' premises, etc. The rectangular shape makes it possible to furnish in this portable model, any one of the three types of Bristol's Ammeter Coils for 8-inch round charts.

A similar model 616 is available for movement using 6-inch charts.

For A. C. movement the standard winding is 5 amperes and intended for use with standard instrument transformer. Other self-contained ranges for A. C. or D. C. up to 200 and 300 Amperes can be furnished.

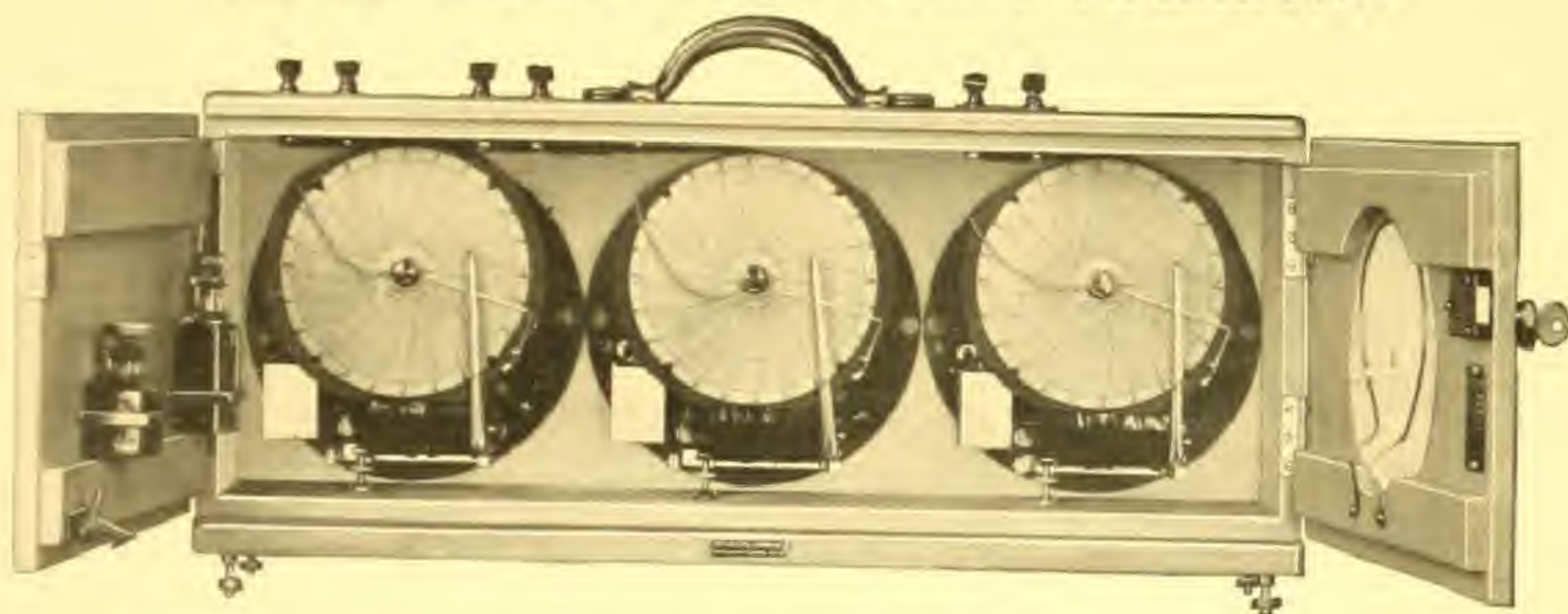
A two-speed clock can be furnished, which for making surveys and investigating complaints is an especially desirable feature in the portable instrument. See page 25 for complete information.



Although the ink method of recording is standard, the carbon coated chart for some uses is preferred, and can be furnished when desired. This particularly applies when instrument will be installed where exposed to extremes of temperature. The carbon coated chart is not effected by

heat and cold, and insures a record at all times. Also, under rapid load fluctuating conditions the record line is clearly defined and easy to read. With the Bristol's Ammeter Movement direct marking penarm and same "V" shaped pen are used as for ink record.

### THREE PHASE RECORDING AMMETER



This equipment includes three Bristol's Recording Ammeter Movements mounted side by side, which offers a most convenient arrangement for obtaining continuous or simultaneous records of three phase circuits. A single instrument or even two, would not give true comparison, as readings would necessarily be taken on different days and with probable varying current conditions. Another use for this comparison is to furnish records of current for three single phase circuits.

It is an easy matter to set up the equipment in the field—simply run leads from the binding posts to the line.

The movements shown are for 6-inch charts, but similar equipment using the 8-inch charts can also be furnished.

The case in which the ammeter movements are mounted, is made of wood with natural varnish finish. The complete outfit is light in weight and easily carried by one person.

### FRICTIONLESS FOUNTAIN PEN

For recording over periods of time longer than 24 hours, the fountain pen is desirable. It provides an ample supply of ink even under conditions of rapid fluctuation.

To eliminate any possible friction and make practical the use of fountain pen on Bristol's Recording Electrical Instruments, the penarm like that shown in illustration, equipped with hinged pivot is available. Such a device insures constant contact with the chart and at a minimum of friction.





### RANGE

The round chart models of recording ammeters shown here can be furnished for A. C. or D. C. They are calibrated for all ranges of D. C. as required by commercial practice; but for higher ranges of A. C. they are wound for use with current transformers and can be used with any standard instrument transformer of the proper ratio. While it is stated instruments can be furnished for either A. C. or D. C., they are not regularly interchangeable.

### OPERATION

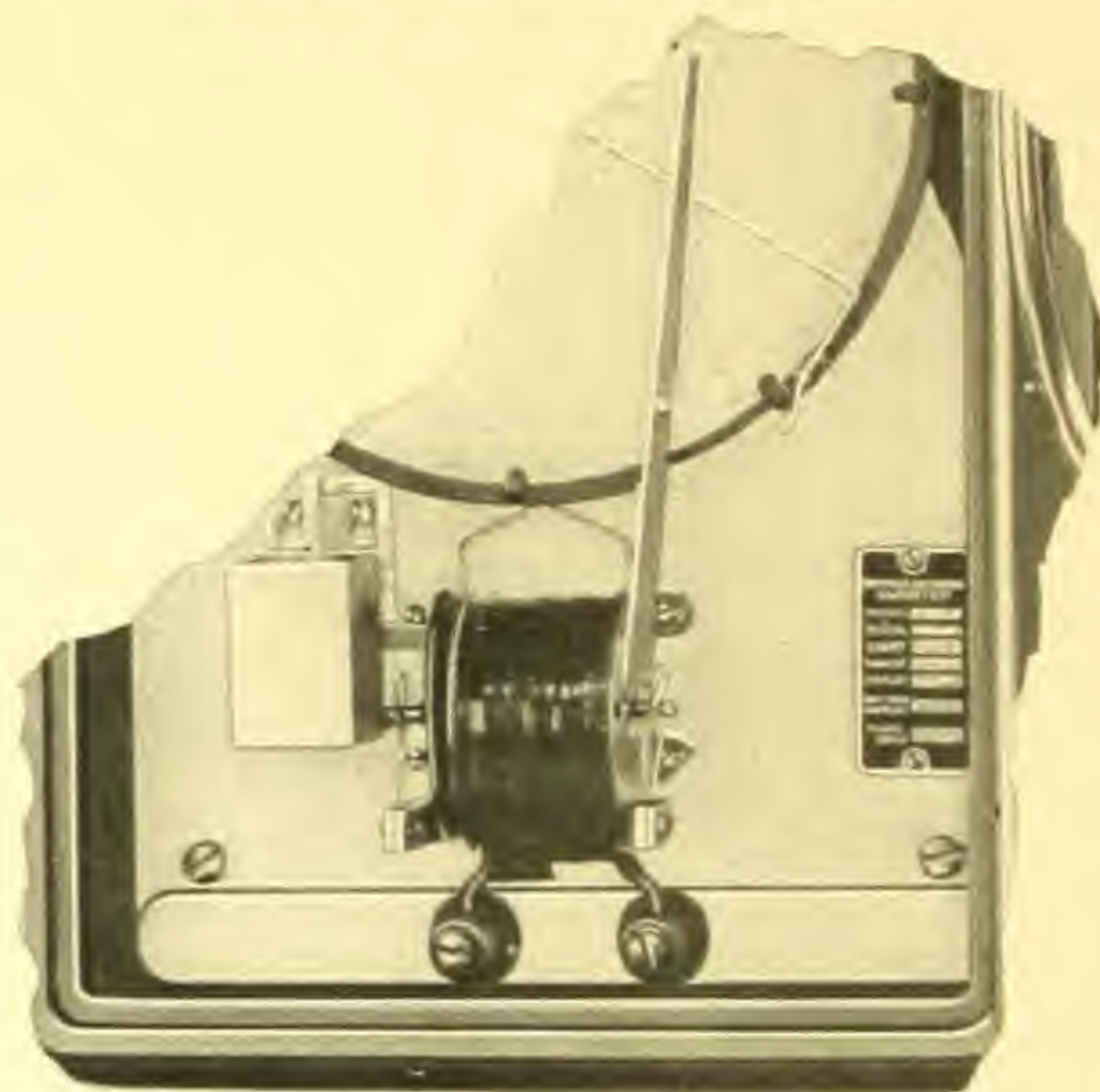
The electrical elements used in Bristol's Round Chart Recording Ammeters fall into two general types, the "Attractive Disc" and "Soft Iron Plunger." The "Attractive Disc" is further divided into "Short Coil" and "Long Coil" types. These each have characteristics which adapt them for certain classes of work.

### CHART CHARACTERISTICS and MOVEMENTS

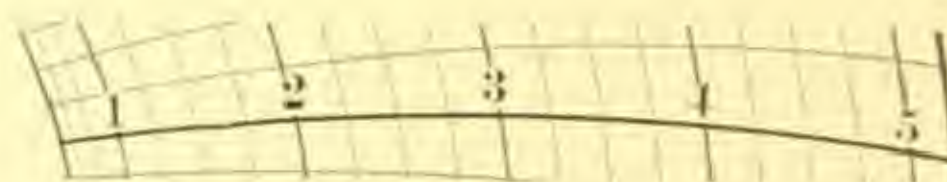
Probably the greatest number of Bristol's Recording Ammeters now in use are equipped with the Short Coil Attractive Disc Type of Movement. It is recognized for sturdiness and accuracy under long continuous service, and high torque is also one of the desirable features. This movement can be furnished for A. C. in any of the models using 8-inch charts. The popular range is 0 to 5 amperes, with a suitable chart depending on primary loads to be recorded. Also furnished for D. C. in ranges as desired. The 5 ampere instrument has an approximate power consumption of 6 watts, with 30 per cent power factor.

Charts with the Attractive Disc Short Coil Type of Movement have increasing scale, thus providing wide open graduations in the higher part of the scale. This fact should be kept in mind when selecting chart.

### ATTRACTIVE DISC SHORT COIL MOVEMENT



Here is illustrated the Attractive Disc Short Coil Movement which produces chart having increasing scale graduations.



Specimen chart section having increasing scale graduations as produced by Attractive Disc Short Coil Movement.

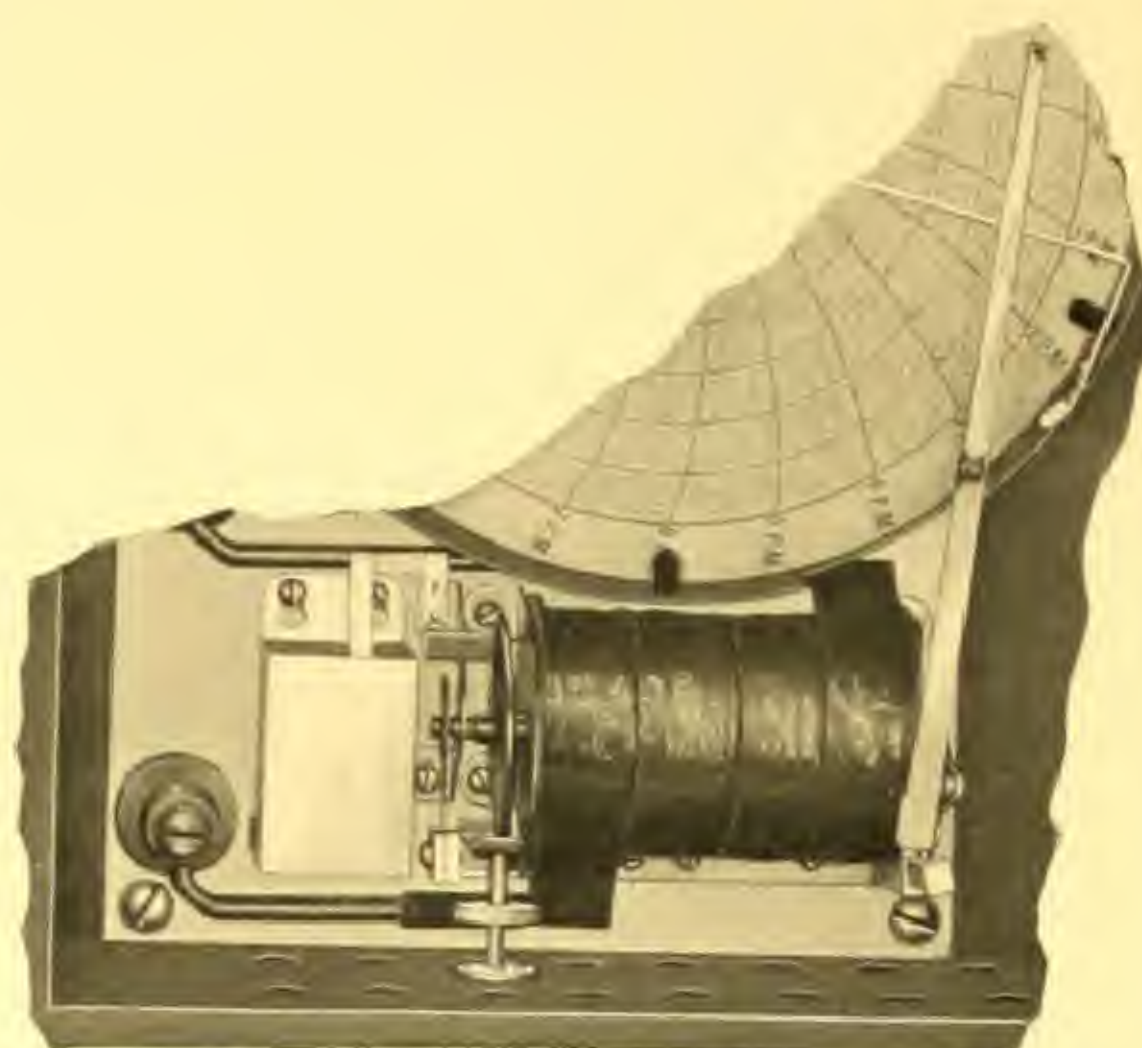
### LIST OF AMMETER CHARTS WITH INCREASING SCALE GRADUATIONS

For A. C. or D. C.  
8-Inch Charts Used with Models  
610, 612, 622, 635, 640 and 655

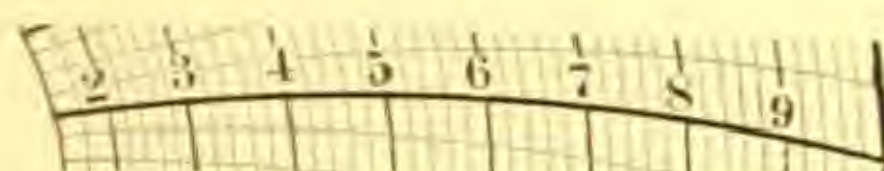
CHART NUMBER	RANGE AMPERES	REV.
1406	0-5	24 Hr.
1469	0-5	7 Day
412	0-10	24 Hr.
1474	0-10	7 Day
446	0-20	24 Hr.
439	0-25	24 Hr.
434	0-25	7 Day
453	0-50	24 Hr.



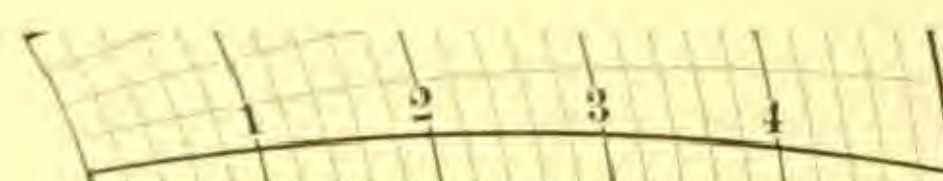
CHART NUMBER	RANGE AMPERES	REV.
1422	0-50	7 Day
438	0-60	24 Hr.
417	0-100	24 Hr.
405	0-125	24 Hr.
408	0-125	7 Day
413	0-150	24 Hr.
407	0-150	7 Day
1417	0-200	24 Hr.
1473	0-250	24 Hr.
435	0-300	24 Hr.
488	0-300	7 Day
402	0-400	24 Hr.
1402	0-500	24 Hr.
443	0-600	24 Hr.
405	0-600	7 Day
409	0-800	24 Hr.
433	0-1000	24 Hr.
468	0-1200	24 Hr.
410	0-1200	7 Day
497	0-1600	24 Hr.
1420	0-2000	24 Hr.
416	0-2500	24 Hr.
1486	0-3000	24 Hr.
1413	0-4000	24 Hr.
499	0-5000	24 Hr.



This is the Attractive Disc Long Coil Movement used in Bristol's Recording Ammeters for charts having uniform graduations.



6-Inch Charts Used with Models 616, 640, 647, 655



Section of chart with uniform scale graduations produced by the Attractive Disc Long Coil Movement.

CHART NUMBER	RANGE AMPERES	REV.
3110	0-10	24 Hr.
3104	0-30	24 Hr.
3103	0-50	24 Hr.
3101	0-100	24 Hr.
3109	0-150	24 Hr.
3114	0-200	24 Hr.
3113	0-250	24 Hr.
3108	0-300	24 Hr.
3115	0-400	24 Hr.

### LIST OF AMMETER CHARTS WITH UNIFORM SCALE GRADUATIONS

For A. C. or D. C.  
8-Inch Charts Used with Models 612, 622, 635, 640, 655

CHART NUMBER	RANGE AMPERES	REV.
1425	0-5	24 Hr.
1418	0-5	7 Day
1454	0-10	24 Hr.
1451	0-15	24 Hr.
1453	0-50	24 Hr.
1439	0-80	24 Hr.
1404	0-100	24 Hr.
1493	0-150	24 Hr.
1432	0-200	24 Hr.
1492	0-200	7 Day
1488	0-250	24 Hr.
1497	0-250	7 Day
1491	0-300	24 Hr.
1489	0-600	24 Hr.

### ATTRACTIVE DISC LONG COIL MOVEMENT

It is often desirable to average the chart record of load in amperes, especially records of test on motors or lighting circuit. In such cases the Attractive Disc Long Coil Movement producing chart with uniform scale over the entire range lends itself. Also where load conditions are fairly constant, the uniform scale is used to advantage.

This type of movement is available in all models for both 8-inch and 6-inch charts.

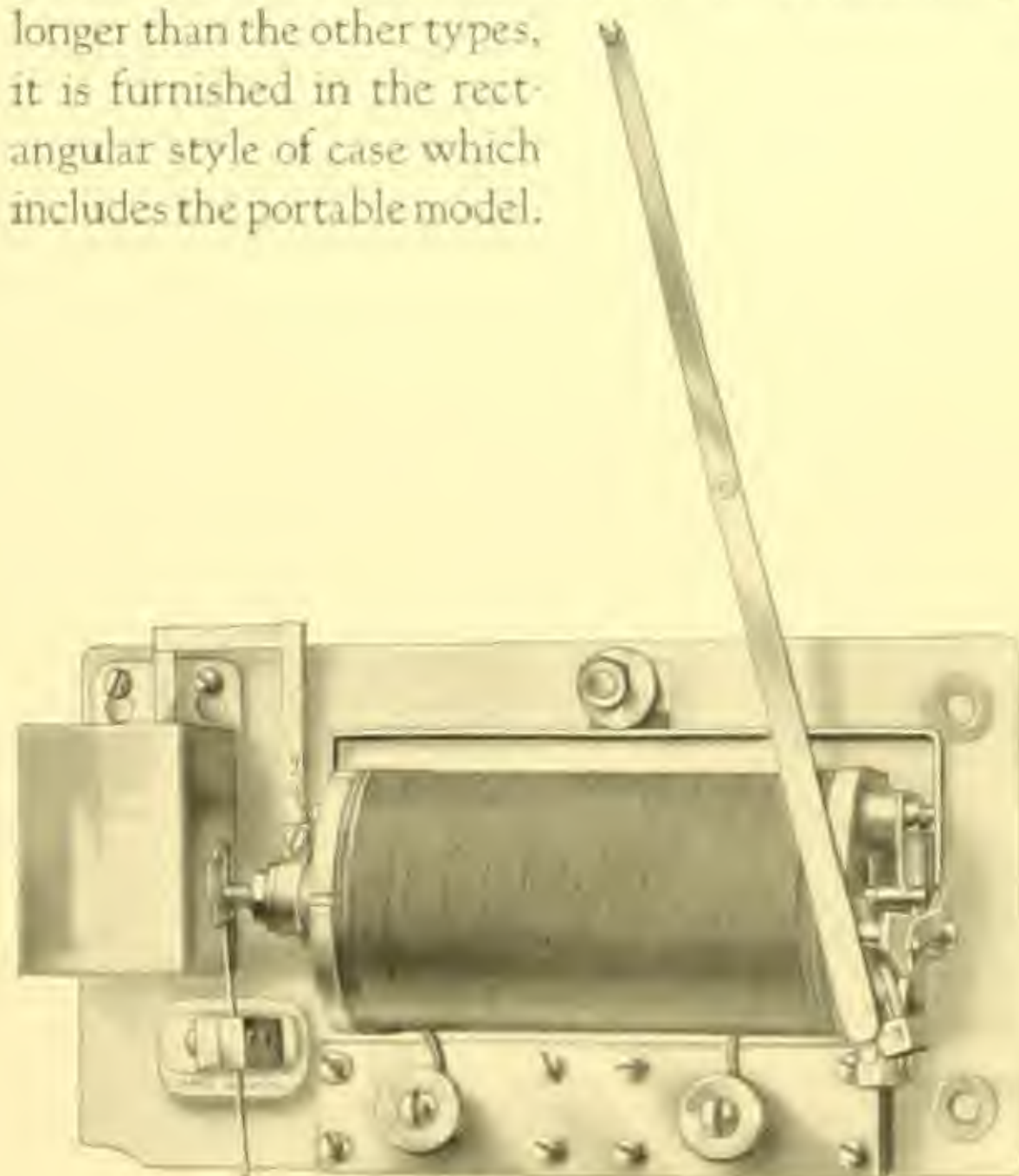



 6-Inch Charts Used with  
 Models 616, 640, 647, 655

CHART NUMBER	RANGE AMPERES	REV.
3100	0-5	24 Hr.
3102	0-50	24 Hr.
3120	0-100	24 Hr.

### SOFT IRON PLUNGER TYPE of MOVEMENT

When instrument is desired with full scale range and fairly open reading over entire range, the "Soft Iron Plunger Type" of movement is recommended. This class of movement produces charts with increasing scale according to Law of Squares, and is known as the Law of Squares Chart. Because this movement is considerably longer than the other types, it is furnished in the rectangular style of case which includes the portable model.



Movement known as "Soft Iron  
Plunger Type" which produces  
charts with increasing gradua-  
tions according to Law of Squares.


 Chart section having gradua-  
tions according to Law of  
Squares.

### LIST OF AMMETER CHARTS WITH LAW OF SQUARES SCALE GRADUATIONS

For A. C. or D. C.

8-Inch Charts Used with  
Models 612, 622, 635, 640, 655

CHART NUMBER	CHART AMPERES	REV.
7005	0-5	24 Hr.
7004	0-10	24 Hr.
7006	0-10	7 Day
7001	0-50	24 Hr.
7002	0-100	24 Hr.
7003	0-200	24 Hr.

### DAMPING DEVICE

An oil damping device is furnished as part of the standard equipment with all Bristol's Recording Ammeters of the Round Chart Type. It consists of a vane moving in a container of oil, and the degree of damping is regulated by the grade of oil used.

This oil damping device is shown in connection with illustration of individual movements.

### TRANSFORMER

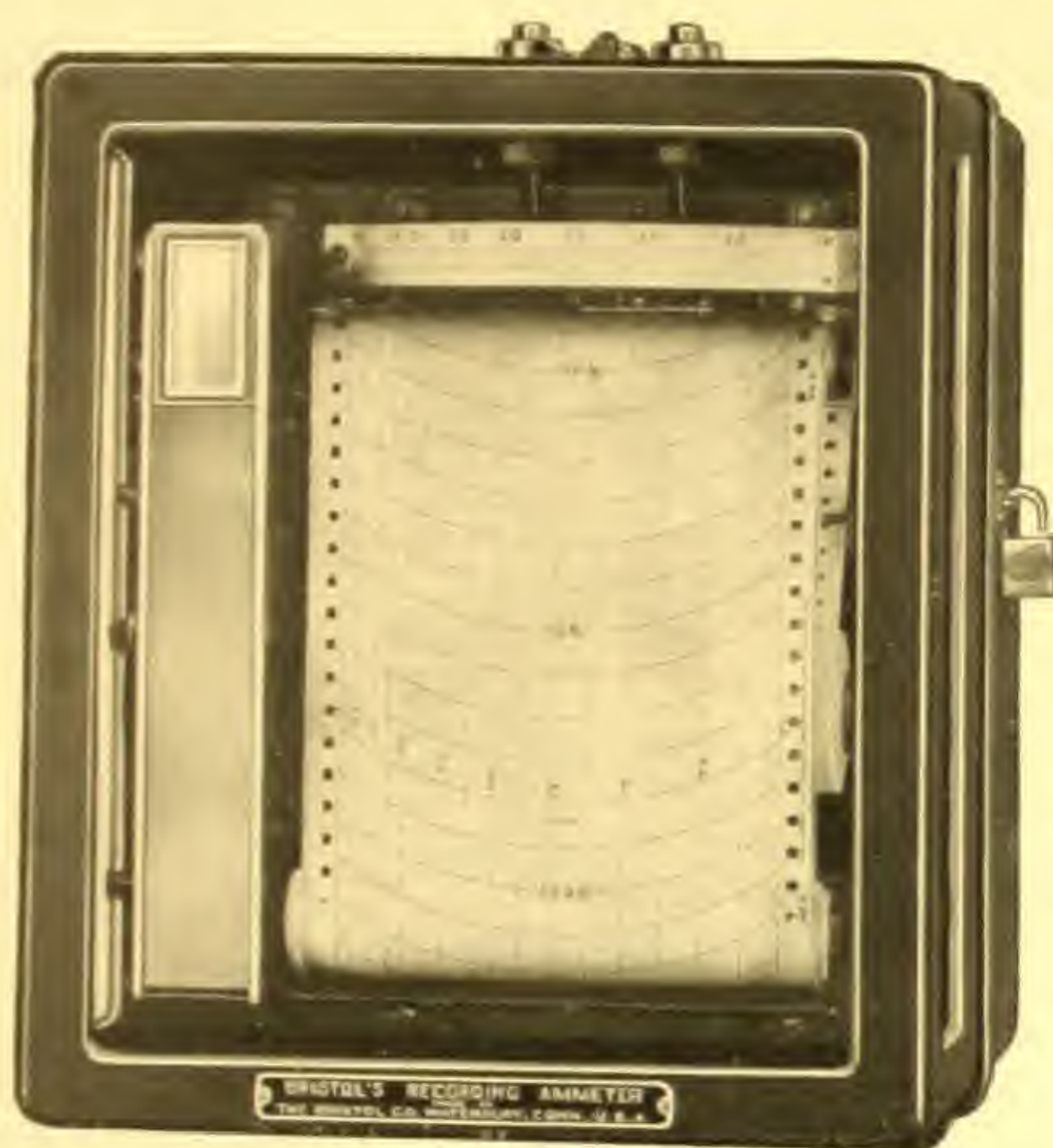
Any standard instrument transformer having a secondary winding of 5 amperes may be used with Bristol's Recording Ammeters, and charts are available for all standard ratios.

When conditions make it necessary, instruments can be furnished to order with secondary winding other than 5 amperes.

The transformers are not part of regular ammeter instrument equipment, but included only when specified.



## STRIP CHART RECORDING AMMETERS



Model 625 for Permanent Mounting  
Using Rewind Roll for Chart

## LONG CONTINUOUS RECORD

Unbroken records of current over a period of time including 45, 30 or 15 days are available in the Strip Chart Recording Ammeter.

## CLOSE ACCURACY IN READING

The open scale is a characteristic of the strip chart, and recommends the instrument where close accuracy in reading details is desired.

## CHARTS

The full width of the chart is 6-inches with actual scale of 5 1/4-inches. They are furnished in rolls 90-feet long. As may be noted in the specimen chart on page 3 the scale markings are in orange color with figures and time arcs and main scale divisions in black. This background, and the black record provides a very distinctive combination so that the record line and its values are easily read.

The chart is furnished on a stock roll and inserted in the instrument in this form. The chart

may be installed for use in two ways. With that part of the chart having record on a rewind roll which makes the last 9-inches of the record visible and as illustrated on this page. Also with that part of the chart having record passing through slot in the bottom of case and using a clip to keep it taut, as illustrated on page 18. This method permits removal of portions of the chart at convenient intervals.

In case it is desired to remove chart immediately after record is made, a stripper roll can be supplied which makes this possible without interfering with regular operation of instrument.

DIRECT MARKING  
INK RECORDING SYSTEM

The penarm is mounted above the chart, and consists partly of a fine hollow tube and extension projecting downward to the ink reservoir. The other end just resting on the chart. In operation the ink siphons to the recording tip, where capillary attraction causes the record to be made.

It is essential that all possible friction be eliminated in recording, and for this purpose the recording arm is equipped with a threaded end on which is mounted a balance screw. This provides an adjustment so close that the pointer may barely touch the surface of the chart.

One filling of the ink reservoir is generally sufficient to last for one winding of the clock. This applies except in very unusual operating conditions. When the chart is operated at the speed of 1-inch, 3-inches or 6-inches per hour, the clock requires winding once every 7 days. When operated at faster speeds, it is necessary to wind the clock more often. The standard recording instrument ink furnished with Bristol's Strip Chart Instruments is black.



## STRIP CHART RECORDING AMMETERS

### PERMANENT INDICATING SCALE

In addition to the charts on recording system, each instrument is equipped with a permanent scale and pointer. The pointer is part of the recording penarm, and indicates continuously the current as it is recorded. Such a pointer serves as a convenient spotter and makes it easy to read the current being recorded, even at some distance from the instrument.

### RANGE

The Strip Chart Ammeter is furnished as required to take care of all commercial ranges including both A. C. and D. C.

### ELECTRICAL MOVEMENT and CHART SCALE

Two types of electrical movements have been selected as best suited to take care of the variety of work required for the strip chart ammeters. These include "Dynamometer" and "D'Arsonval Weston Movement." The application of instrument determines the selection.

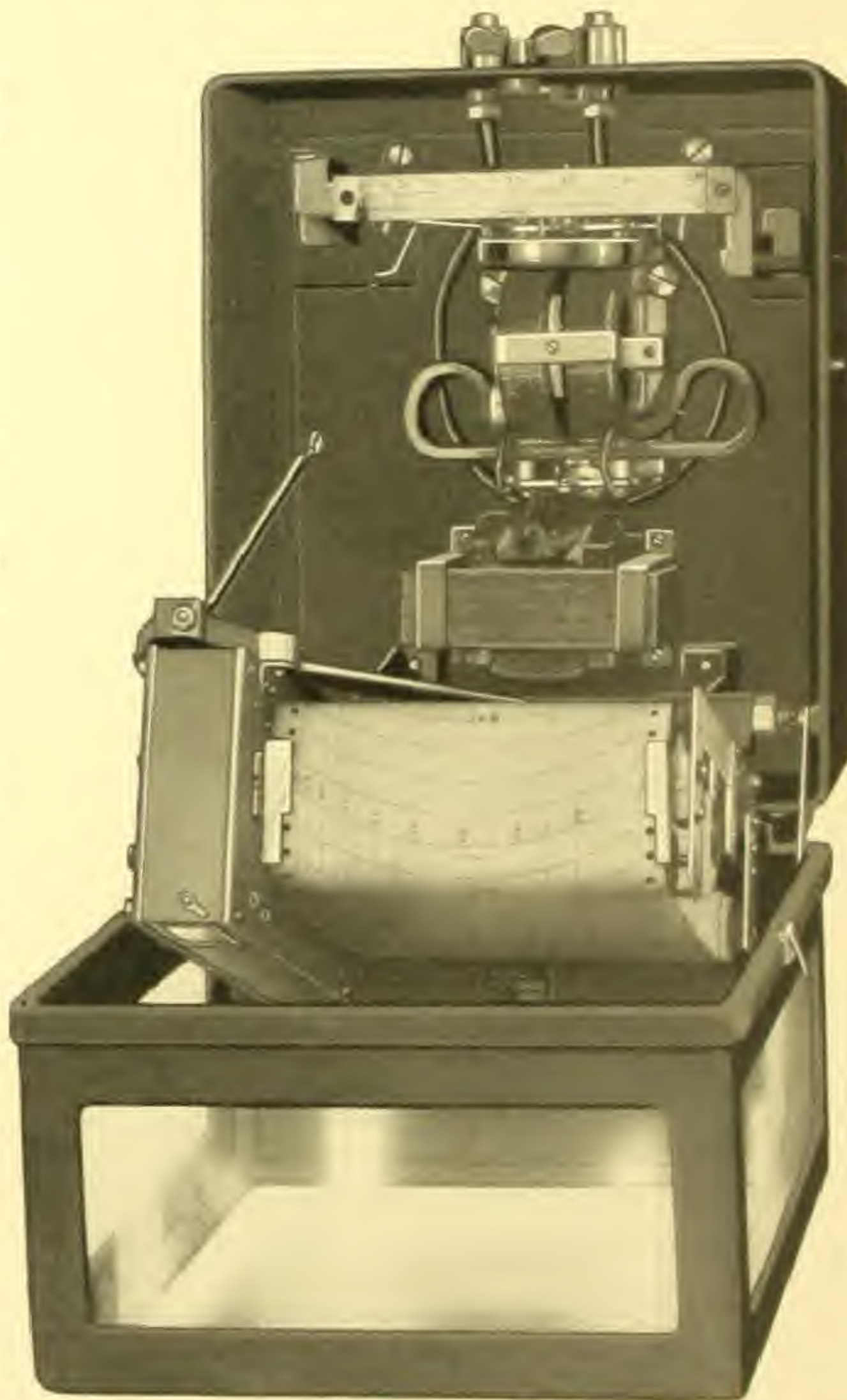
For alternating current the Dynamometer Movement has proven the one best adapted. In fact, an accuracy of  $1\frac{1}{2}$  per cent or better of total scale range is usual with this movement.

The movement is wound to carry one ampere, and a current transformer is mounted inside the instrument, having ratio 1 to 5, thus making it a standard 5 ampere recorder. This method makes possible a very powerful movement without shunting movable coil or taking away power available in instrument. The 5 ampere instrument has an approximate power consumption of 8 watts, with 60 per cent power factor.

The charts with dynamometer movement are increasing according to Law of Squares, and should be selected for use so that the operating range falls within the more open scale portions. This provides a clear, open, easy-to-read record.

The electrical movement recommended for direct current is the "Weston," which operates on the D'Arsonval principle, but revised to make it suitable for commercial purposes. Among the changes is the elimination of delicate suspensions and substitution of double pivots. For direct current this movement will give an accuracy of  $1\frac{1}{2}$  per cent or better over full scale range.

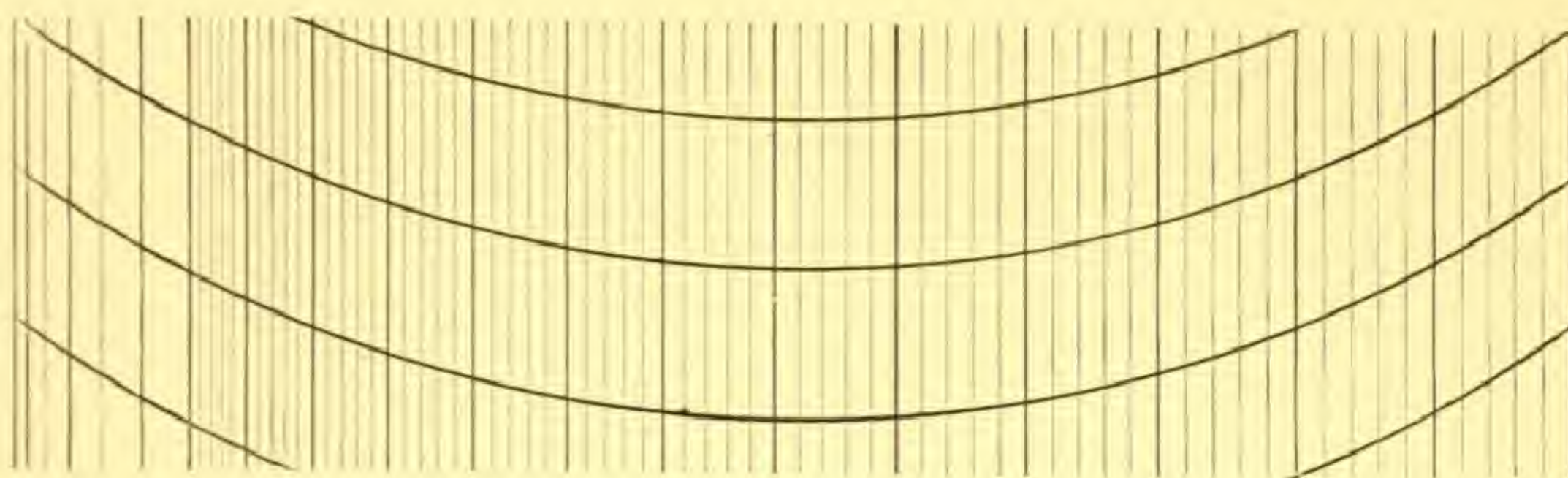
The chart scale with Weston Movement is uniform over the entire scale.



Ammeter Model 625  
Showing Interior Construction



## STRIP CHART RECORDING AMMETERS



SPECIMEN SECTION OF STRIP CHART HAVING INCREASING SCALE GRADUATIONS

(This is characteristic of full range charts graduated according to law of squares)

BRISTOL'S AMMETER STRIP CHARTS WITH  
INCREASING SCALE GRADUATIONS

Dynamometer Movement for A. C.

Used with Models 625, 626

CHART NUMBER	RANGE AMPERES	CLOCK SPEED	CHART NUMBER	RANGE AMPERES	CLOCK SPEED	CHART NUMBER	RANGE AMPERES	CLOCK SPEED
S401	0-5	1	S409	0-40	6	S414	0-200	3
S404	0-5	3	S406	0-80	1	S405	0-300	3
S408	0-5	6	S416	0-100	3	S411	0-400	3
S420	0-10	3	S407	0-100	6	S417	0-500	3
S421	0-10	6	S418	0-125	3	S415	0-800	3
S419	0-15	3	S413	0-200	1	S403	0-1500	6
						S412	0-3000	3

## DAMPING DEVICE

A magnetic damping device is part of the standard equipment on all Bristol's Ammeters using Dynamometer Movement. However, an oil damping method can be furnished to order and is recommended where excessive fluctuations are involved and a dead-beat movement is necessary.

## CLOCK

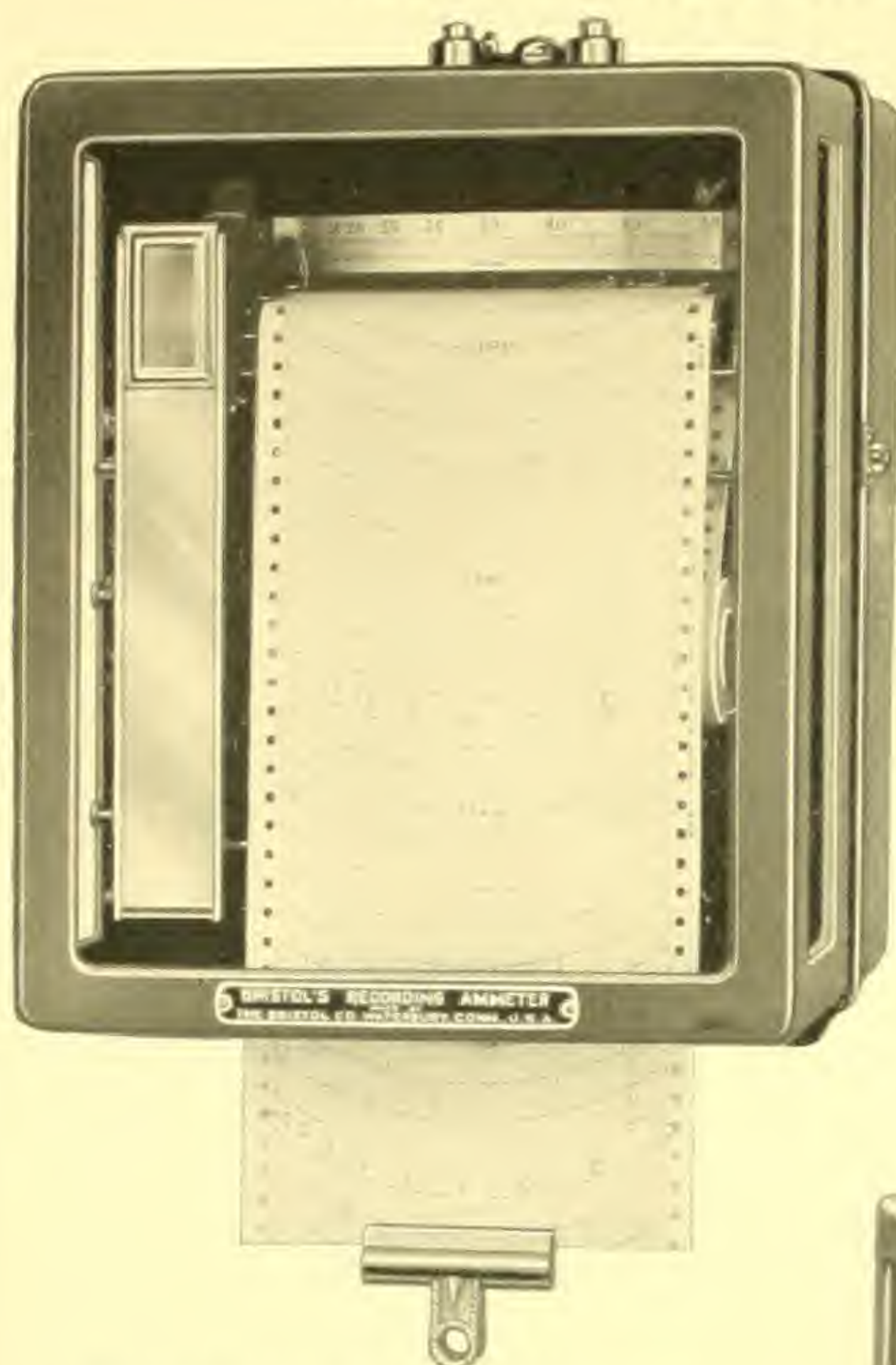
Heavy duty clock especially designed for the work is furnished in the strip chart instrument. Its function is to drive the chart roll and in doing this, it also serves to control the chart speed. Because time arcs are marked off on the chart, it is thus possible to know at what time any current condition takes place.

The clock speeds are 1, 3 and 6 inches per hour. A change from one to another speed can be made by a simple substitution of gears. Each set of gears is mounted on a plate, and it is only necessary to remove two screws to make the change. Three sets of gears are standard equipment with each instrument. Furthermore, by the simple shifting of a lever, faster speeds of 1, 3 and 6 inches per minute may be had, depending upon the gears in position. Other speeds can be furnished to order.

When desired, an electric motor operated clock can be furnished in place of the spring motor type. For more complete description of this, see page 26.



## STRIP CHART RECORDING AMMETERS



Model 625 for Permanent Mounting  
with Chart passing through  
bottom of Case.

### INSTRUMENT CASE ADAPTED TO WORK IN HAND

The type of case housing the movement has an important part in adapting the instrument to the particular work required. Bristol's Recording Strip Chart Ammeters are furnished in cases suitable for mounting on switchboard or wall, also in portable model for carrying about.

These cases are made of metal and glass, sufficiently rigid to amply support the movement and prevent any possibility of getting out of alignment. They are dust-proof in construction and not only com-

pletely protect the movement, but are sufficiently rugged to stand up for a period of many years even though exposed to fairly severe conditions. A properly constructed case materially keeps down the cost of maintenance.

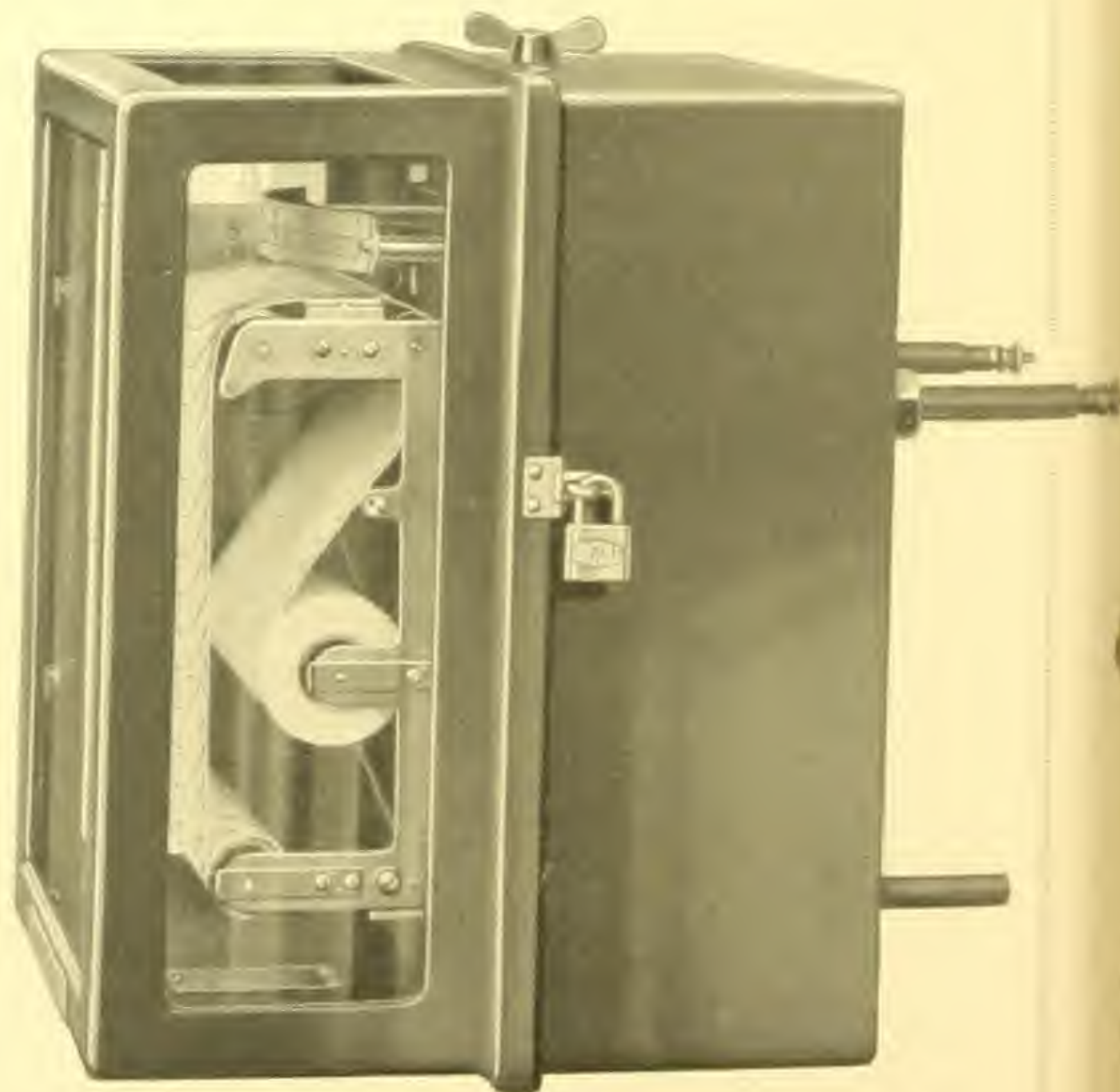
The finish of the case is high grade black enamel.

### WALL TYPE

The instrument illustrated on pages 15 and 18 is Model 625, intended for mounting on wall or other support, and equipped with lugs for supporting the instrument and electrical connections are made by suitable binding posts at the top. Such instruments may be mounted at any convenient place, on the wall, posts, etc., for observation. Overall dimensions of case with door closed, length 14 inches, with door open 20 inches; width 10 7/8 inches; depth 10 inches.

### SWITCHBOARD MODEL

The switchboard type of strip recording ammeters have supports and electrical connections at the back, so that when mounted the connections do not show. Overall dimensions of case with door closed, length 14 1/2 inches, with door open 20 inches; width 10 7/8 inches; depth 10 inches. See illustration below.



Ammeter Model 625 side view showing Terminals for  
Switchboard Mounting.



## STRIP CHART RECORDING AMMETERS

## PORTABLE MODEL

The movement in the portable ammeter is same as that used in model for permanent installation. The all metal case, which is aluminum, supplies the necessary rigidity required for instrument of precision. At the same time it is light in weight, a desirable feature for portable purposes. The finish is black enamel. A leather handle is provided for convenience in carrying.

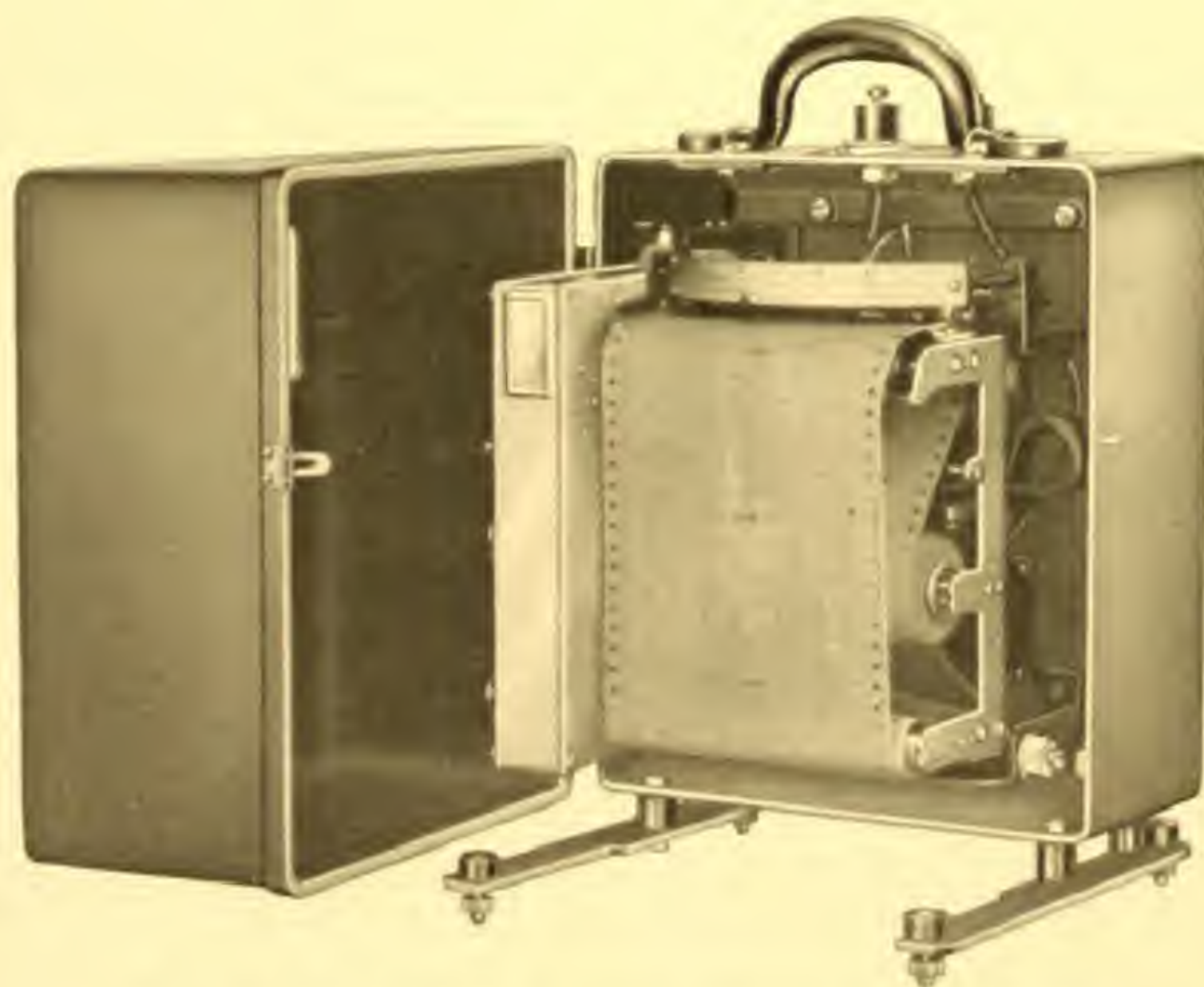
The base is provided with adjustable leveling screws. However, the instrument is so designed that it is not essential to use extreme care in adjusting to level.

While 5 amperes is standard, this instrument can be used on 10 ampere load or higher without use of additional external transformer.

A portable recording ammeter like this is particularly serviceable for checking motors, individual power and lighting circuits, laboratory test work, etc.



Portable Model 626



Portable Model 626 showing interior construction

MOTION, ETC.

MOTION, ETC.



## RECORDING SHUNT AMMETERS



For Switchboard or Wall Mounting, Shunt Ammeter Model 637.

For direct current work the Recording Shunt Ammeters described here are specially intended. They are used for recording in connection with Direct Current Loads, Storage Battery Charge and Discharge, D. C. Rotary Converter, Electric Railway Line, Telephone Line, Electro-plating, etc.

### ELECTRICAL MOVEMENT

A milli-voltmeter movement of the D'Arsonval Weston Type is used in all Bristol's Recording Shunt Ammeters.

### FRICTIONLESS (Carbon Coated Chart) RECORDING SYSTEM

The carbon coated chart method of recording is used on all Bristol's Recording Shunt Ammeters. With this method, a clear, well defined record is assured, and even under rapidly fluctuating operation conditions. Extremes of heat or cold do not effect the efficiency. Also, what is very important in recording, friction between pen and chart

is reduced to a minimum. This is an essential feature because any other system using considerable electric power would necessarily interfere with the accuracy.

With the carbon coated chart can be used either a mechanically vibrated penarm which comes in contact periodically with the sensitized surface, or a direct marking penarm, depending on the range in millivolts of shunt.

With the vibrating penarm each contact of the pen with the chart leaves a white dot. The result is a succession of dots which is practically a continuous line. But with the direct marking system, the pen is in constant contact with chart. In using either method, on removing, the chart is dipped into a fixative solution which makes the record permanent.

For tests and observations conducted along scientific lines where automatic records are required, they are usually accomplished with the carbon coated chart.



Moisture-Proof Model 639 Shunt Ammeter for Permanent Mounting.



## RECORDING SHUNT AMMETERS

## RANGE

The standard calibration with the vibrating method of recording is 0-50 millivolts. This permits any range of external shunt if calibrated for drop of 50 millivolts across the terminals. With direct marking recording system, the standard calibration is 0 to 100 millivolts, with external shunt having 100 millivolt drop across terminals.

Other ranges can be furnished if desired, or several ranges in one instrument with switch to change readily from one to the other.

## CHART CHARACTERISTICS

The charts resulting from the movement used in Bristol's Recording Shunt Ammeters have uniform scale over the entire range. Thus the record of minimum and peak load variations is equally efficient.



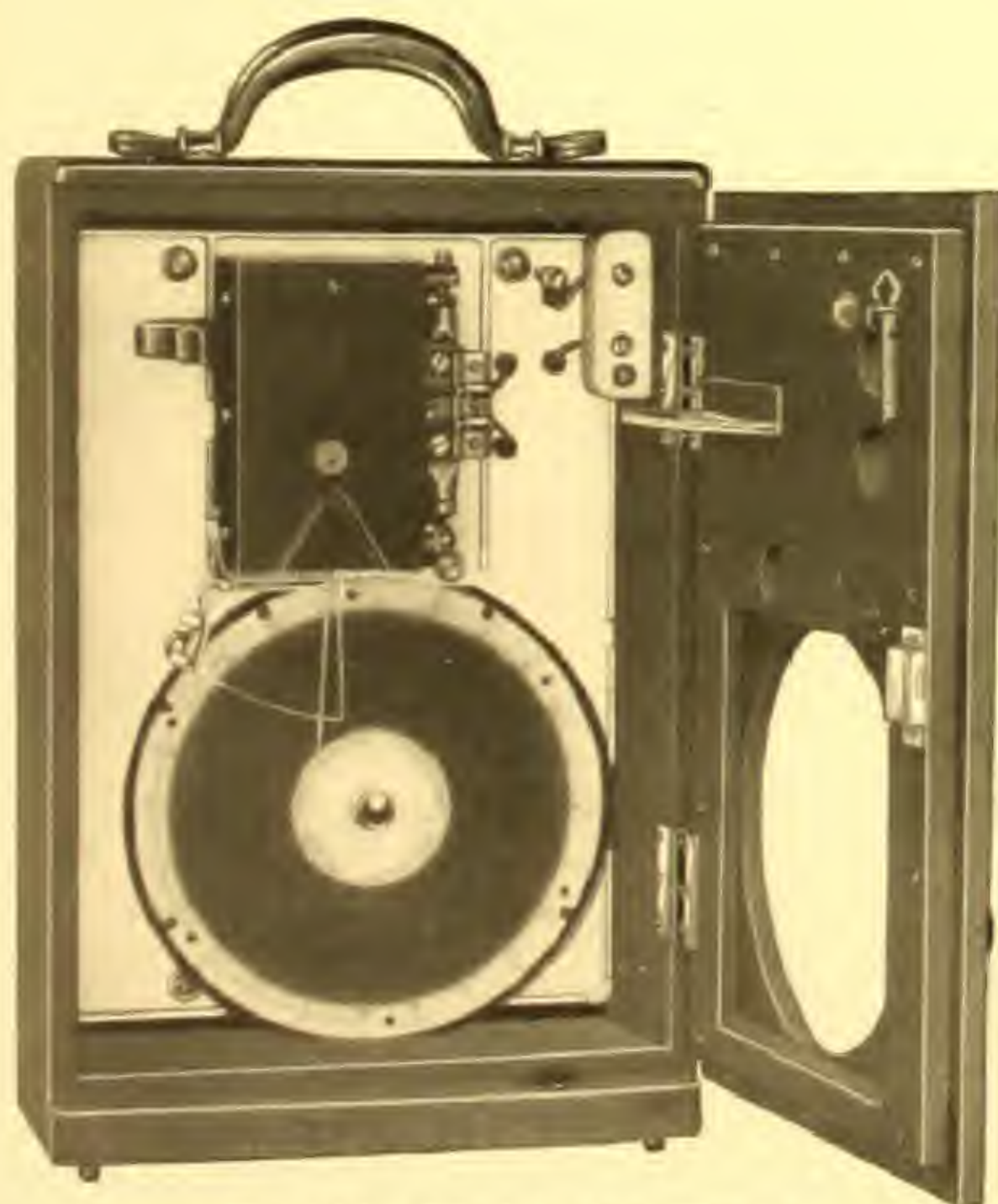
Portable Model 614 Shunt Ammeter.

## CLOCK

The clock movement is employed to revolve the chart and with the vibrating penarm, to periodically press the penarm against the chart. With this system, when the clock is operated at 24-hour speed the penarm is brought in contact with the chart every 5 seconds.

## CASE DIMENSIONS

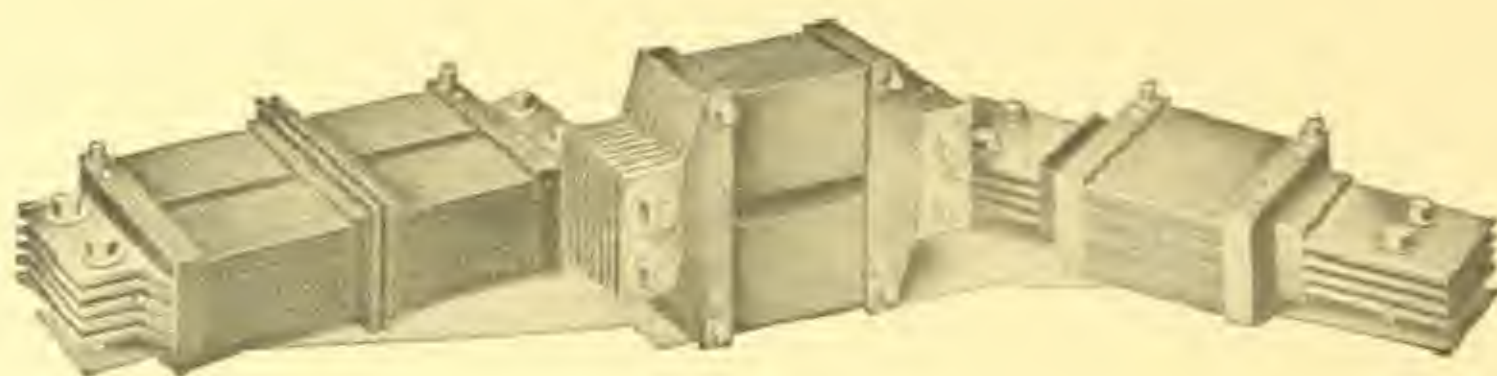
Overall dimensions Recording Shunt Ammeter Model 637, Length 17  $\frac{3}{8}$  inches; Width 11  $\frac{3}{4}$  inches; Depth 4  $\frac{1}{2}$  inches. Model 639, Length 18 inches; Width 12  $\frac{3}{4}$  inches; Depth 5  $\frac{1}{4}$  inches.



Portable Model 614 Shunt Ammeter with door open showing movement.



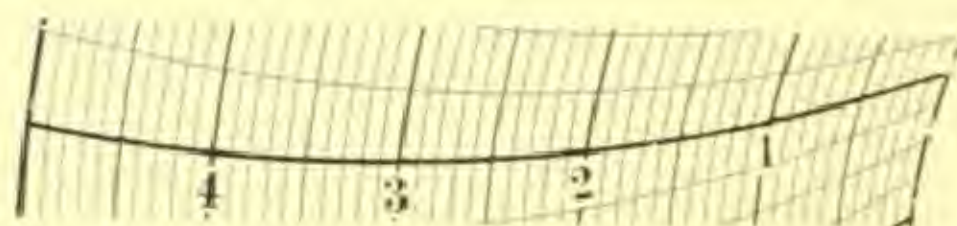
## RECORDING SHUNT AMMETERS



### SHUNTS

External shunts available in several types. The selection depends upon the service for which instrument is to be used. Some of the shunts used are illustrated.

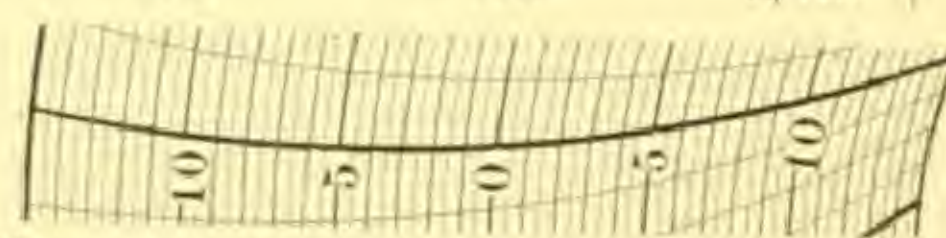
### Chart Characteristics



SPECIMEN ROUND CHART SECTION HAVING UNIFORM SCALE GRADUATIONS ON ARC  
 (Characteristic Chart used with "Weston" D. C. Movement)

### LIST of AMMETER CHARTS WITH UNIFORM SCALE GRADUATIONS ON ARC For "Weston" D. C. Movements—Direct Marking or Vibrator Type 8-Inch Charts used with Models 614, 624, 637, 639

CHART NUMBER	RANGE AMPERES	REV.	CHART NUMBER	RANGE AMPERES	REV.	CHART NUMBER	RANGE AMPERES	REV.
1519	0-5	24 Hr.	1513	0-400	24 Hr.	1505	0-2500	24 Hr.
1507	0-50	24 Hr.	1558	0-500	24 Hr.	1573	0-3000	24 Hr.
1537	0-80	24 Hr.	1501	0-600	24 Hr.	1503	0-3500	24 Hr.
1542	0-100	24 Hr.	1536	0-750	24 Hr.	1571	0-4000	24 Hr.
1538	0-150	24 Hr.	1504	0-1000	24 Hr.	1511	0-5000	24 Hr.
1512	0-200	24 Hr.	1547	0-1200	24 Hr.	1540	0-6000	24 Hr.
1517	0-250	24 Hr.	1521	0-1500	24 Hr.	1562	0-10000	24 Hr.
1539	0-300	24 Hr.	1544	0-2000	24 Hr.	1553	0-20000	24 Hr.

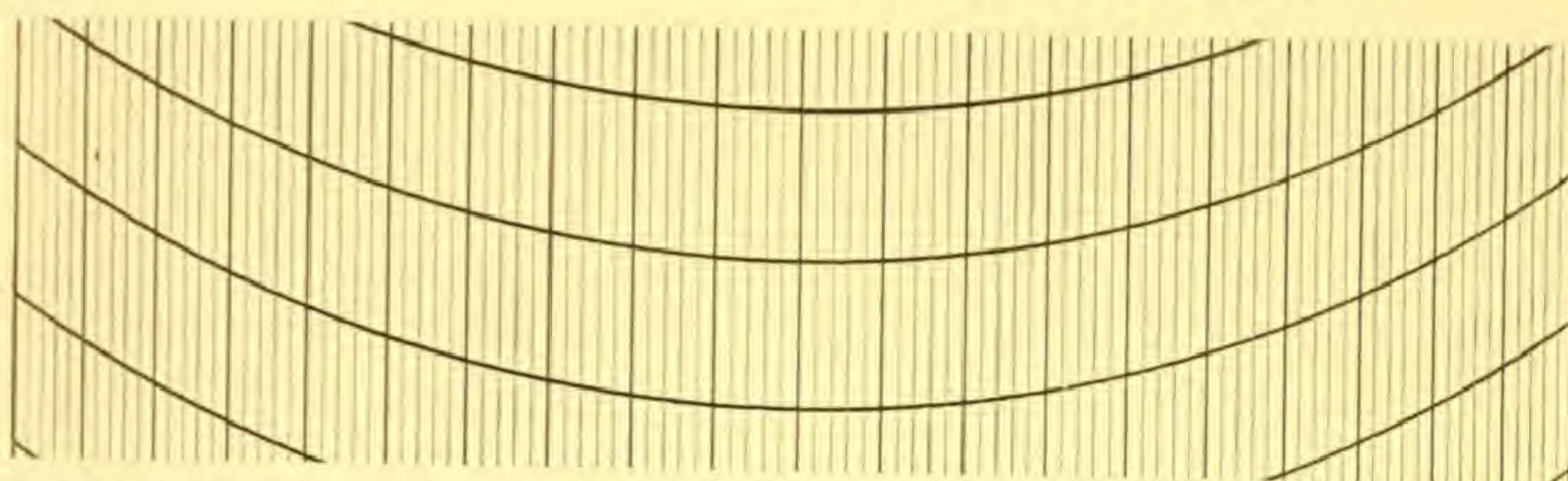


(Characteristic Chart having Zero Center)

CHART NUMBER	RANGE AMPERES	REV.	CHART NUMBER	RANGE AMPERES	REV.	CHART NUMBER	RANGE AMPERES	REV.
1500	5-0-5	24 Hr.	1522	150-0-150	24 Hr.	1568	1200-0-1200	48 Hr.
1534	15-0-15	24 Hr.	1531	100-0-200	24 Hr.	1543	1000-0-2000	24 Hr.
1506	75-0-100	24 Hr.	1572	1000-0-1000	48 Hr.	1563	2000-0-2000	24 Hr.



## RECORDING SHUNT AMMETERS

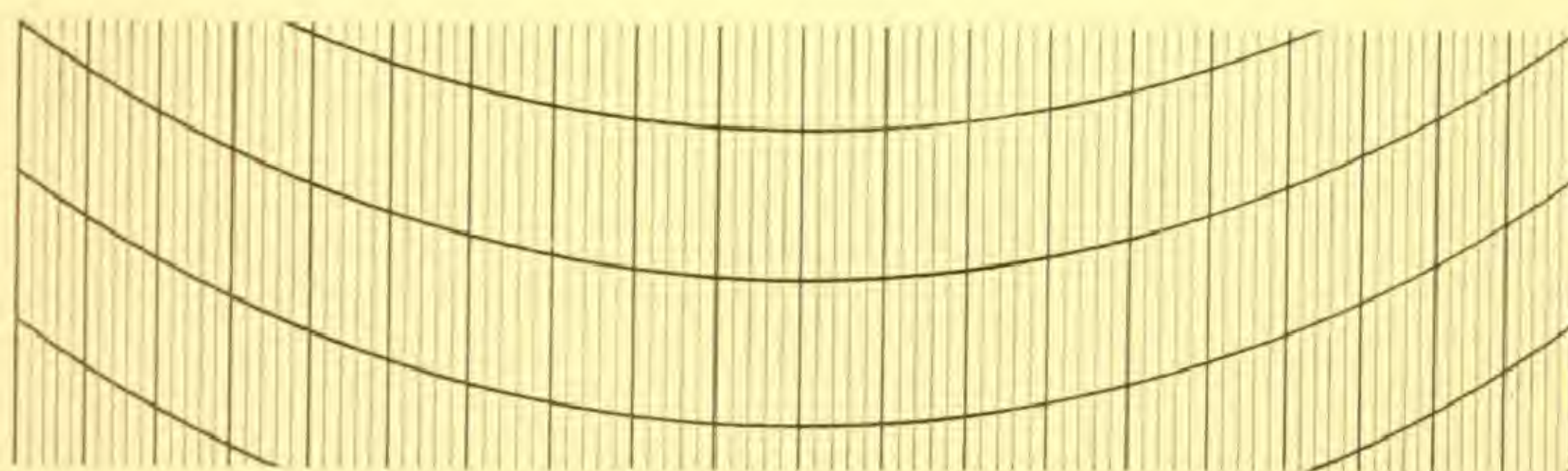


SPECIMEN SECTION OF STRIP CHART HAVING UNIFORM SCALE GRADUATIONS  
(Characteristic Chart used with D. C. Movements)

LIST of SHUNT AMMETER STRIP CHARTS  
HAVING UNIFORM SCALE GRADUATIONS

For "Weston" D. C. Movements—Direct Marking  
Used with Models 625, 626

CHART NUMBER	RANGE AMPERES	CLOCK SPEED	CHART NUMBER	RANGE AMPERES	CLOCK SPEED	CHART NUMBER	RANGE AMPERES	CLOCK SPEED
S1510	0-10	3	S1522	0-400	1	S1547	0-2000	1
S1524	0-50	3	S1527	0-400	3	S1505	0-2000	3
S1520	0-100	1	S1541	0-500	1	S1513	0-2500	3
S1509	0-100	3	S1515	0-500	3	S1507	0-3000	3
S1521	0-100	6	S1538	0-600	1	S1501	0-4000	1
S1528	0-150	3	S1526	0-600	3	S1546	0-4000	3
S1544	0-150	6	S1506	0-750	1	S1502	0-5000	1
S1525	0-200	3	S1512	0-800	3	S1518	0-5000	3
S1520	0-200	6	S1500	0-1000	1	S1540	0-6000	1
S1531	0-250	3	S1504	0-1000	3	S1523	0-6000	3
S1508	0-300	3	S1530	0-1500	1	S1519	0-7000	3
S1543	0-300	6	S1514	0-1500	3	S1516	0-8000	3



SPECIMEN STRIP CHART SECTION HAVING UNIFORM SCALE GRADUATIONS ON ARC  
(Characteristic Chart having Zero Center used with "Weston" D. C. Movement)

LIST OF SHUNT AMMETER STRIP CHARTS  
HAVING UNIFORM SCALE GRADUATIONS ON ARC

Used with Models 625, 626

CHART NUMBER	RANGE AMPERES	CLOCK SPEED	CHART NUMBER	RANGE AMPERES	CLOCK SPEED	CHART NUMBER	RANGE AMPERES	CLOCK SPEED
S1536	10-0-10	1	S1534	100-0-200	3	S1532	100-0-400	3
S1503	100-0-100	3	S1533	100-0-300	3	S1535	200-0-600	3

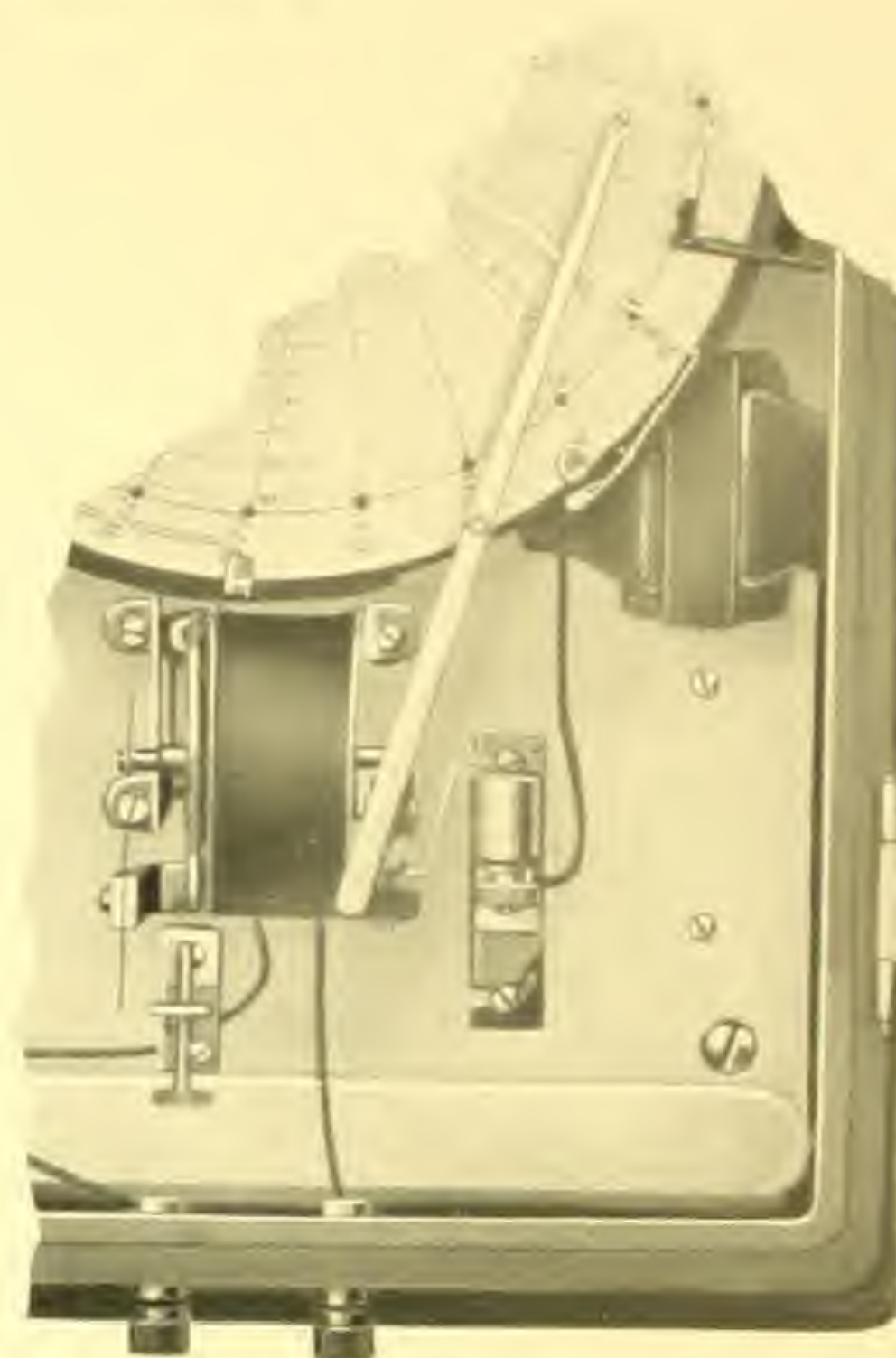


## SIGNAL ATTACHMENT

Sometimes it is desirable to have a warning of minimum or maximum conditions, or both. For such places a contactor equipment as shown in illustration can be furnished with Bristol's Recording Ammeters to operate a signal or sound alarm. For example, a Recording Ammeter when used to determine load on individual motors can be equipped to sound alarm at critical point of overload.

The necessary power for operating alarm attachment can be supplied from dry cells or lighting circuit.

The signal attachment is furnished in rectangular cases Models 635 and 640. Instruments of these models already in the field may also be equipped.



## ELECTRIC TIME ATTACHMENT



The Penarm at right operates  
as Time Recorder

In order to explain certain changes in record made on ammeter chart, it is also necessary to know the time of operations of relays, motors, and other similar devices. Such information is conveniently supplied on the same chart by equipping the instrument with an auxiliary penarm, which is connected to these devices and thus defines the record made.

The auxiliary penarm is known as Electric Time Penarm Attachment and may be furnished with Model 647 as illustrated, also with Rectangular Model 635. This penarm can be operated in parallel from circuit to which instrument is connected.



## THE CLOCK USED WITH BRISTOL'S RECORDERS

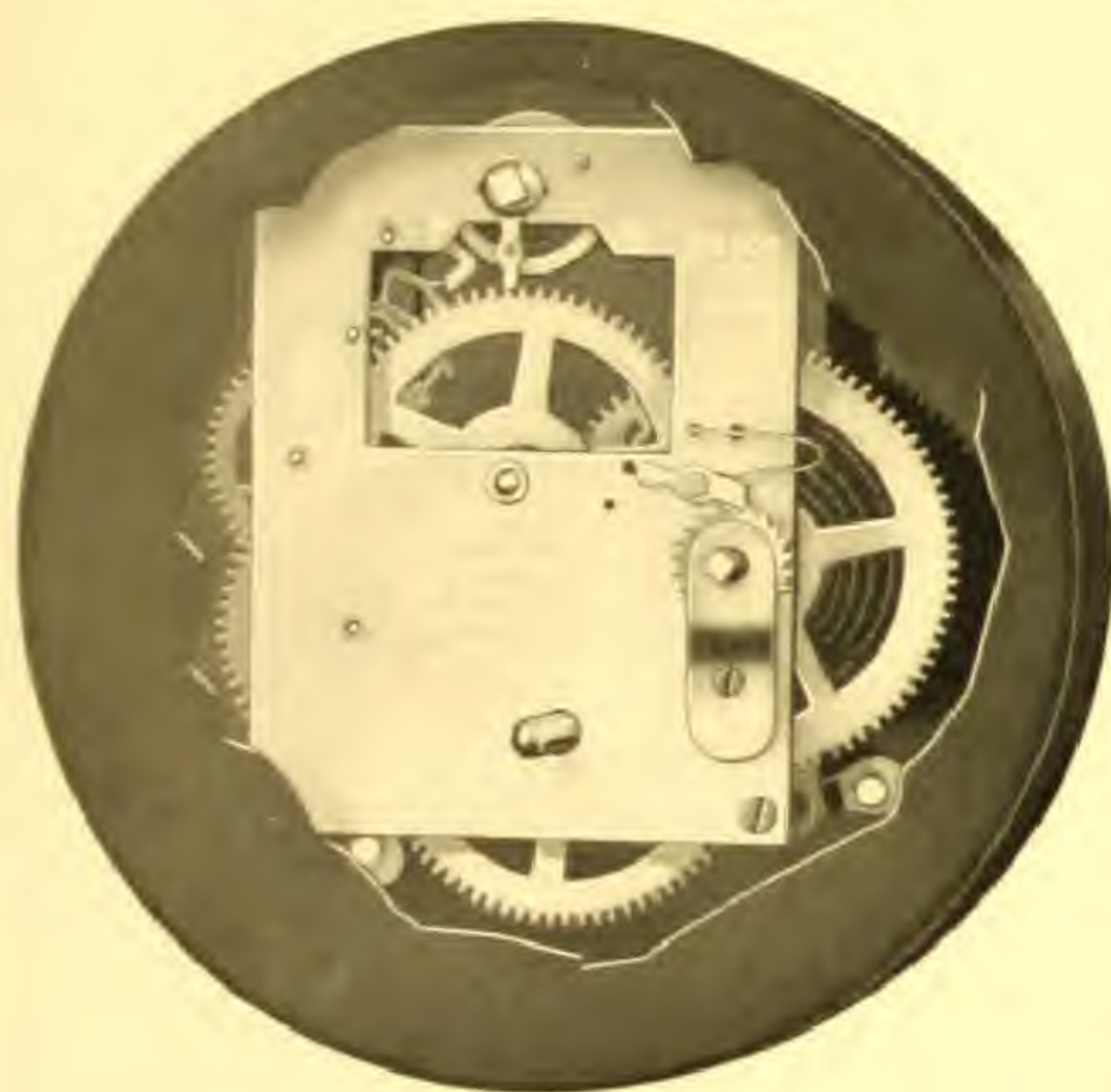
In every Bristol's Recording Ammeter Instrument there is a clock movement used to operate the chart, so that not only the amount of current can be read on the chart, but the time at which it occurs is also shown.

ary to furnish a clock having the speed to correspond with that of the chart, as an example, 24-hour clock for 24-hour revolution chart, likewise 7-day clock for 7-day revolution chart.

### TWO-SPEED CLOCKS

The portable instruments are generally used for investigative work for engineering purposes or running down complaints. In using the instruments it sometimes develops that the one speed clock does not cover all the requirements, and very often the portable instruments are furnished equipped with two speed clock capable of changing immediately from 7-day speed to 24-hour by the simple turning of arbor. In employing the portable instrument for these purposes, it is the usual practice to start with record covering a long period of time, for instance 7 days. However, when upon examining record, if unusual discrepancies have occurred then it is well to have a record with magnified cycle, and the two speed clock easily accomplishes this by shifting to a high rate of speed, such as 24-hours, etc. Other speeds available are 24 hour-12 hour, 24 hour-6 hour, 24 hour-1 hour, etc.

### SPRING MOTOR CLOCK

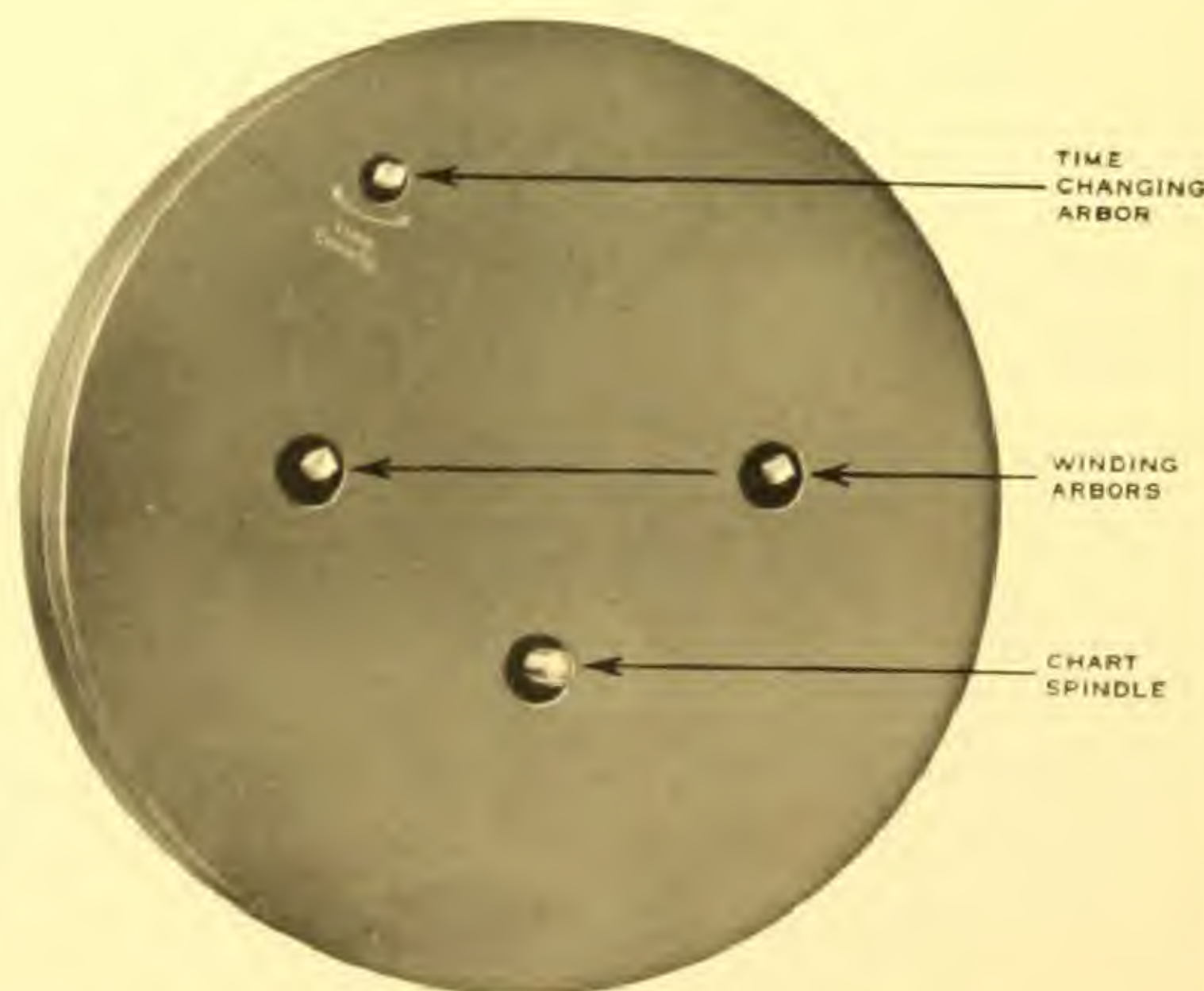


"Seth Thomas" Spring Motor Clock as used in Bristol's Round Chart Recording Ammeters.

The clock regularly furnished with Bristol's Round Chart Recording Ammeters is of the spring motor type, "Seth Thomas" make, specially designed for the work.

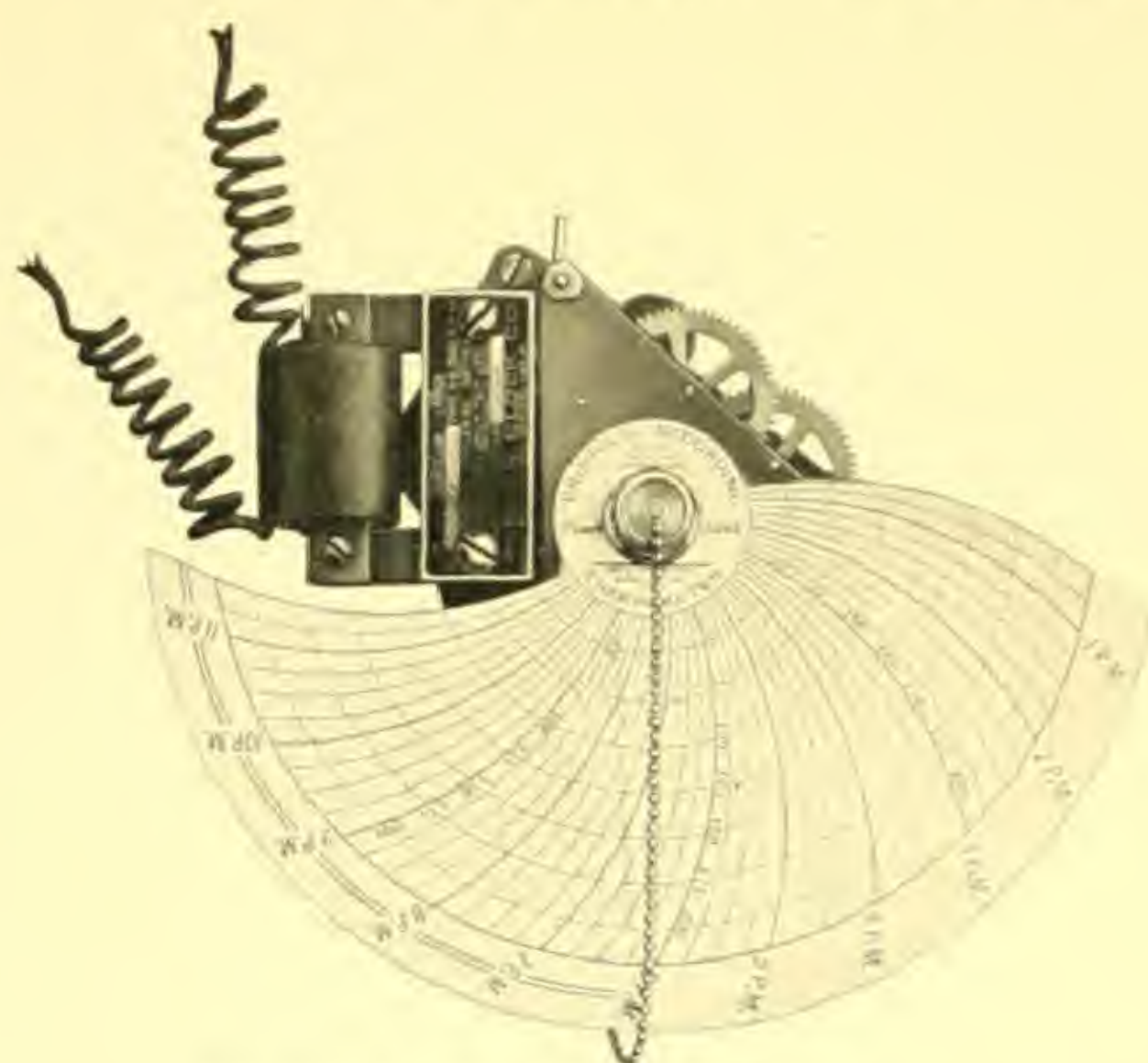
### CLOCK SPEEDS

Recording charts furnished with Bristol's Ammeters can be furnished marked off in time arcs suitable for 24 hours, 7 days, or other speeds as required. In using the charts arranged for the various speeds, it is custom-



"Two-Speed" Spring Motor Clock furnished when required in Round Chart Recording Ammeters.



**ELECTRIC MOTOR OPERATED CLOCK**

Electric Motor Operated Clock used with Round Chart Instruments. This clock can be furnished for 24-hour or 7-day revolutions.

In place of the spring motor clock, Bristol's Ammeters can be furnished equipped with electrically operated clock. This not only eliminates the necessity for winding, but when several recorders are equipped with the electric clocks, it is possible to have all charts operating in unison. The electric clock furnished with Bristol Recorders is the "Warren Telechron Motor Clock." It operates on alternating current where frequency is known to be constant or where power system has synchronous frequency. It can be furnished to use for 60, 50, 40 or 25 cycles. When electric clock is required, be sure to specify voltage and frequency.



For use with Strip Chart Instruments the motor operated clock shown here can be had for 3, 6 or 12-inch per hour speeds.

Like the spring motor, the electric clock is available for different speeds such as 24 hour and 7 day revolutions on round chart recorders, and for 1, 3, 6 or 12-inches per hour speeds on strip chart recorders. Other speeds can be furnished if desired.

**ACCURATE CHARTS NECESSARY**

Every Recording Ammeter and Shunt Ammeter is calibrated to be used with the particular chart specified. This makes it necessary that every chart must be identical without even the slightest variation, in order to insure accuracy. For this reason, every attention is given to the finest details which make Bristol's charts absolutely accurate and reliable under all conditions.

Even the paper on which Bristol's charts are printed is made specially for the purpose. The

charts are printed in our own plant from extremely accurate engravings, and under uniform humidity conditions.

The accuracy of Bristol's Recording Instruments cannot be guaranteed unless genuine Bristol's Charts are used. To identify them, every round chart is printed on paper having water mark reading "Bristol's" and the name of The Bristol Company printed in the center; all strip charts have "The Bristol Company" printed on the side.

For  
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Recorder

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CLOCKS

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## LIST PRICES

For Use with Catalog No. 1502, Ammeter Section

### SERIES AMMETERS

Prices given below include Instrument with Standard Finish Case, 100 Charts, 24 Hour Clock, Bottle of Bristol's Special Recording Instrument Ink with Filler or Dropper, Lock and Two Keys, Clock Key, Damping Device and Bottle of Oil and Mounting Screws or Bolts for permanently mounted Recorders.

#### 8-INCH ROUND CHART MODELS WITH INCREASING SCALE GRADUATIONS (Listed on Pages 12 and 13)

Instrument Model	(SELF-CONTAINED RANGE IN AMPERES)										
	0 to 5	20 to 0-60	60 to 0-200	300	200 to 0-400	400 to 0-800	800 to 0-1200	1200 to 0-1600	1600 to 0-2000	2000 to 0-2500	2500 to 0-3500
610	\$73.00										
612	88.00	\$98.00	\$99.00	\$127.00							
622	104.00										
635	83.00	93.00	94.00	122.00	\$122.00	\$129.00	\$136.00	\$142.00	\$149.00	\$163.00	\$191.00
640	79.00										
655	84.00										

#### 6-INCH ROUND CHART MODELS WITH INCREASING SCALE GRADUATIONS (Listed on Page 13)

616	65.00	75.00	76.00	104.00	104.00
640	57.00				
647	51.00				
655	73.00				

#### 8-INCH ROUND CHART MODELS WITH UNIFORM SCALE GRADUATIONS (Listed on Page 13)

612	94.00	104.00	105.00
622	110.00		
635	89.00	99.00	100.00
640	85.00		
655	90.00		

#### 6-INCH ROUND CHART MODELS WITH UNIFORM SCALE GRADUATIONS (Listed on Page 14)

616	72.00	82.00	83.00
640	63.00		
647	57.00		
655	79.00		

#### 8-INCH ROUND CHART MODELS WITH LAW OF SQUARES GRADUATIONS (Listed on Page 14)

	0-10 Amps.	
612	94.00	94.00
622	116.00	
635	89.00	89.00
640	85.00	
655	90.00	

### CLOCKS

7 Day Any Model	Extra List \$4.00
12 Hour Any Model	No Extra Charge
Two Speed Clock for test work in portables or semi-portables, 24-6 Hr., 24-1 Hr., 24-1/4 Hr., 12-1 Hr., 6-1 Hr.	Extra List 15.00
For other single or two speed clocks to take care of special requirements.	Quoted on Request

### SEMI-PORTABLE

Model 640 or 655 with handle	Extra List 2.50
------------------------------	-----------------

### ADJUSTABLE LUGS

For correcting pole alignment so instrument hangs plumb	" 5.00
---------------------------------------------------------	--------

### METAL DISC OR CIRCLE

For Model 640 in place of glass in door	No Extra Charge
-----------------------------------------	-----------------

MOTION, ETC.



## WARREN TELECHRON CLOCKS

For Round Chart Recorders, 7 day or 24 hour Vibrator Type, Extra List.....	\$35.00
Direct Marking or Bristol Movement 24 hour, Extra List.....	25.00
Other Speeds quoted on request.	
For Strip Recorders, Standard Speeds without rewind, Extra List.....	10.00
Other Speeds or Including rewind, quoted on request.	

## ROUND CHARTS

Smoked (Carbon Coated), for use with Bristol's Recording Ammeters and Shunt Ammeters, size 8-Inch Diam., per 100	\$2.75
Ink Recording, for use with Bristol's Recording Ammeters size 8-Inch and 6-Inch Diameter, per 100.....	.80

## STRIP CHARTS

For use with Bristol's Recording Ammeters, Direct Marking, per Roll 90-Feet Long.....	1.10
Manifold Recording, for use with Shunt Ammeters, per Roll 90-Feet Long.....	1.50

## CHARTS ENGRAVED TO ORDER, quoted on request

## BRISTOL'S SPECIAL RECORDING INSTRUMENT INK

Four-ounce Bottle.....	.65
Pint Bottle.....	1.90
Quart Bottle.....	3.30
Combination Rubber Stopper and Glass Filler.....	.10

## RECORD RIBBON FOR STRIP CHART

Single Color Ribbon for use with Recording Shunt Ammeter, if not otherwise specified purple color will be furnished, each.....	.45
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## FIXATIVE FOR CARBON COATED CHARTS

Fixative Solution, per quart can.....	.80
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## CHART HOLDER FOR WALL OR SHELF USE

Universal Style.....	1.50
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ALL THE ABOVE PRICES ARE F. O. B., WATERBURY, CONNECTICUT

## INSTRUCTIONS FOR ORDERING

When ordering Bristol's Recording Ammeters and Shunt Ammeters, as far as possible give data detailed below:

1. **MODEL.** Specify Model Number and state if wanted for portable use or permanent mounting.
2. **FINISH.** (If other than Standard)
3. **CONNECTIONS.** (Front or Back Connection.) Front Connection is generally furnished for wall mounting, and Back Connection for switchboard. Front Connection will be furnished unless otherwise specified.
4. **CHART.**
  - (a) Round or Strip.
  - (b) Minimum, Maximum and Average operating current values.
  - (c) Chart Number if possible. Refer to list of charts given in catalog.
  - (d) Size of Round Chart, 8-Inches or 6-Inches. (This applies only to Ammeters. Shunt Ammeters and Milli-Ammeters are not furnished in the 6-Inch size.)
  - (e) Kind of Load: Steady, Slightly, Moderately or Extremely Fluctuating.
  - (f) Transformer Ratio if already installed.
5. **KIND OF CIRCUIT.** A. C. or D. C. If for A. C. state frequency. (Shunt Ammeters and Milli-Ammeters are always D. C. Instruments.)
6. **KIND OF MOVEMENT.**
  - (a) Bristol Series Movements, increasing, uniform or law-of-squares types.
  - (b) Weston Movements as used with Shunt Ammeters or Milli-Ammeters.
  - (c) Circuit Resistance and amount of power available to operate Milli-Ammeter.
7. **CLOCK OR SPEED OF CHART.**

Round Chart—24-Hour and 7-Day are standard speeds. Two-speed Clocks furnished as desired, 24-6 Hour, or 24-1 Hour.

Strip Chart—1-Inch, 3-Inches and 6-Inches per hour are standard speeds.
8. **LEADS.** 15-Feet is the standard length of lead always furnished with Shunt Ammeters and Milli-Ammeters. Other lengths should be specified. (No leads are furnished with Bristol Movement Series Ammeters.)
9. **ACCESSORIES.**
  - (a) Transformer if required, state ratio wanted.
  - (b) Extra ranges for Shunt Ammeter. Give ranges in Millivolts desired.
  - (c) Extra ranges for Round Chart Series Movements for the ranges desired.
10. **SHIPPING AND BILLING INSTRUCTIONS.**



## CHART REPLACEMENTS

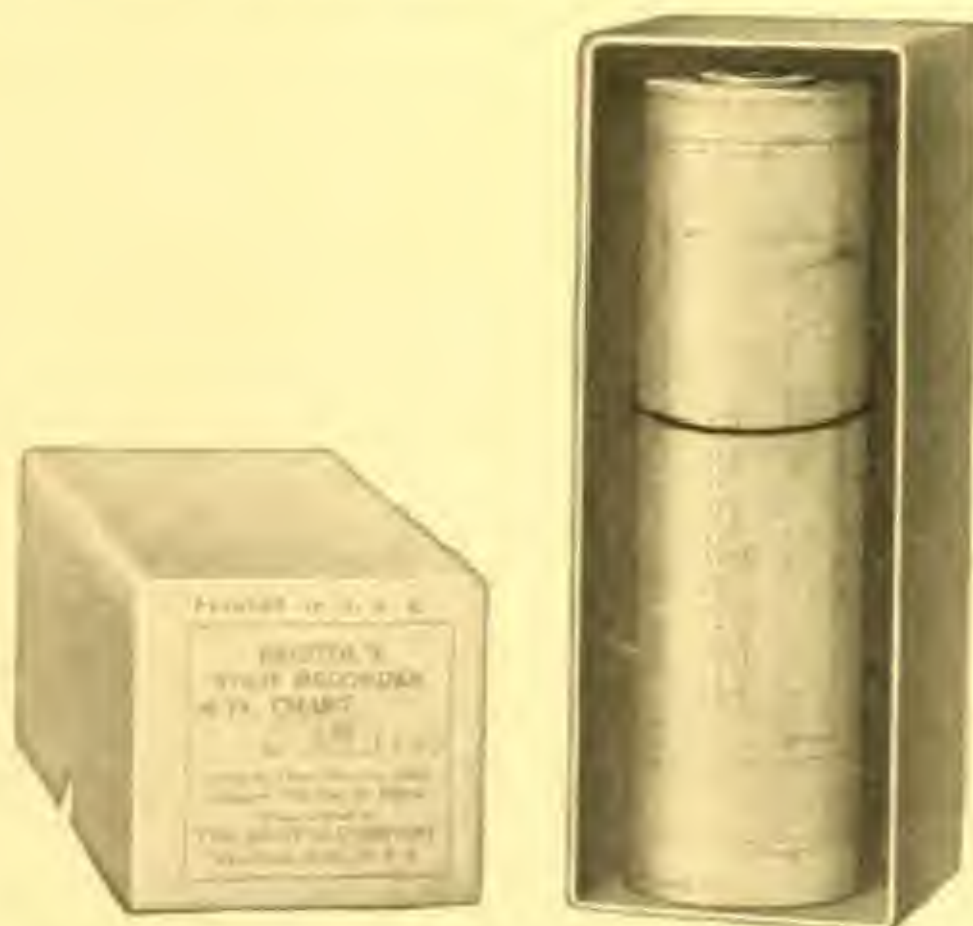


With every new round chart instrument a supply of one hundred charts is included. Additional replacements may be obtained at any time. When ordering specify chart number and kind of instrument.

For convenience, Bristol's Round Charts for ink recording, are packed in boxes containing one hundred each. This facilitates delivery, provides an inexpensive means of filing, and insures clean, unmutated charts.

Smoked (carbon coated) charts are packed in boxes using special separator discs and rings to prevent the sensitized surface from being rubbed off.

New strip chart instruments are furnished with one ninety-foot chart roll. Additional supplies can be furnished as wanted.



## ADDITIONAL SUPPLIES

In addition to charts, the other supplies required are: ink for direct marking instruments; fixative solution for smoked charts; and ink ribbons for manifold recording method.



## SPECIAL INK

Each round chart recording instrument is furnished with a one-ounce bottle of Bristol's Special Recording Instrument Ink. This ink is specially prepared for the purpose. It is slow drying and, one filling of the standard "V" pen insures a perfect record for twenty-four hours or more. The standard color for round charts is red, for strip charts black, but others can be supplied when desired.



## FIXATIVE SOLUTION

After the smoked (carbon coated) chart has been removed from the instrument it is dipped into a fixative solution thus making the record permanent.

With each new recording instrument using smoked charts a one-quart can of Fixative is included. Further supply may be had at any time.

## INK RIBBONS

For use on strip chart recording instruments, not using direct marking system, ink ribbons are furnished. They are similar to those used on typewriters and the standard color is purple.

## UNIVERSAL CHART HOLDER





TRADE MARK  
**BRISTOL'S**  
 REG. U. S. PAT. OFFICE.



## THE BRISTOL COMPANY

Main Office and Factory  
 WATERBURY, CONN., U. S. A.

### BRANCH OFFICES:

BOSTON  
 Consolidated Bldg.

NEW YORK  
 114 Liberty St.

PHILADELPHIA  
 Widener Bldg.

BIRMINGHAM  
 Age-Herald Bldg.

PITTSBURGH  
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DETROIT  
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CHICAGO  
 Monadnock Block

ST. LOUIS  
 Boatmen's Bank Building

DENVER  
 U. S. National Bank Bldg.

SAN FRANCISCO  
 Rialto Bldg.

*The Most Extensive Line of Recording Instruments in the World*

### PRESSURE AND VACUUM

Bristol's Recording Pressure and Vacuum Gauges

### LIQUID LEVEL

Bristol's Recording Water Level Gauges

Bristol-Derr Water Level Gauges for Steam Boilers

### TEMPERATURE

Bristol's Class I Recording Thermometers

Bristol's Class II Recording Thermometers

Bristol's Class III Recording Thermometers

Wm. H. Bristol Indicating and Recording Electric Pyrometers

Bristol's Temperature Controllers

### HUMIDITY

Recording Wet and Dry Bulb Thermometers

### ELECTRICITY

Bristol's Recording Voltmeters

Bristol's Recording Ammeters

Bristol's Recording Wattmeters

W. H. Bristol Recording Milli-Voltmeters

Wm. H. Bristol Recording Shunt Ammeters

Bristol's Recording Frequency Meter

### TIME

Bristol's Electric Time Recorders

### MOTION

Bristol's Mechanical Time Recorders

### SPEED

Bristol's Recording Tachometers

### MISCELLANEOUS

Supplies for Bristol Recording Instruments

Gaugeboard Clocks

Bristol Engine Counters

Bristol Revolution Counters

Bristol-Durand Radii Averaging Instruments

Bristol Patent Safety Set Screws

*Bristol's Patent Steel Belt Lacing - The Perfect Fastener for All Kinds of Belts*



TRADE MARK  
**RISTOL'S** RECORDING ELECTRICAL INSTRUMENTS  
REG. U.S. PAT. OFFICE

Voltmeters      Ammeters      Wattmeters  
Millivoltmeters      Frequency Meters  
Shunt Ammeters

# RECORDING VOLTMETERS

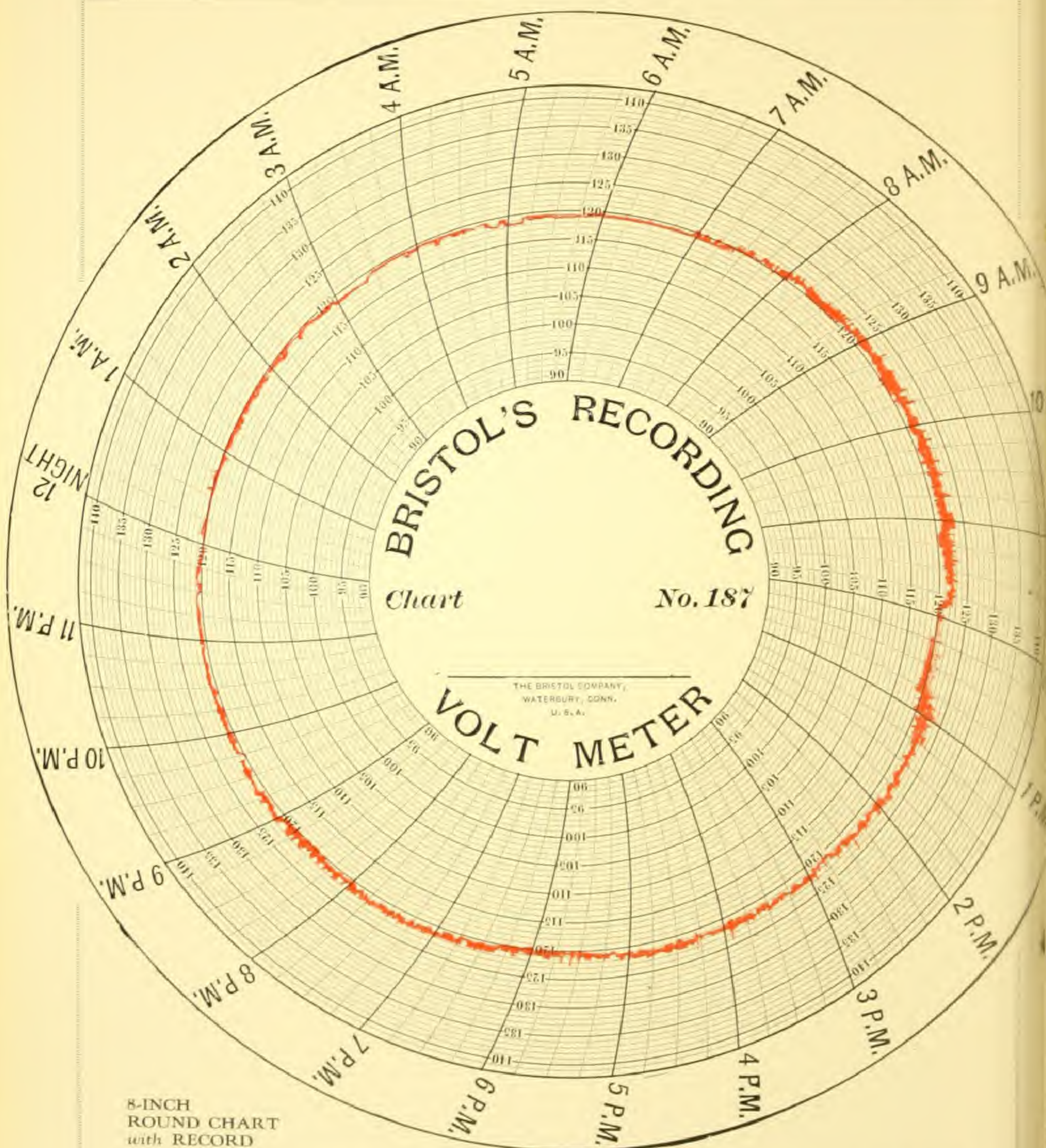


Model 1502 Voltmeter Section

NUMBER 1

MOTION, ETC.





8-INCH  
 ROUND CHART  
 with RECORD

"We are using these recorders for determining the regulation and general voltage conditions on our distribution system. We have six of these in-

struments in constant use." Quoted from letter of a big Western Electric Power Company. The chart reproduced here was also taken from their files.

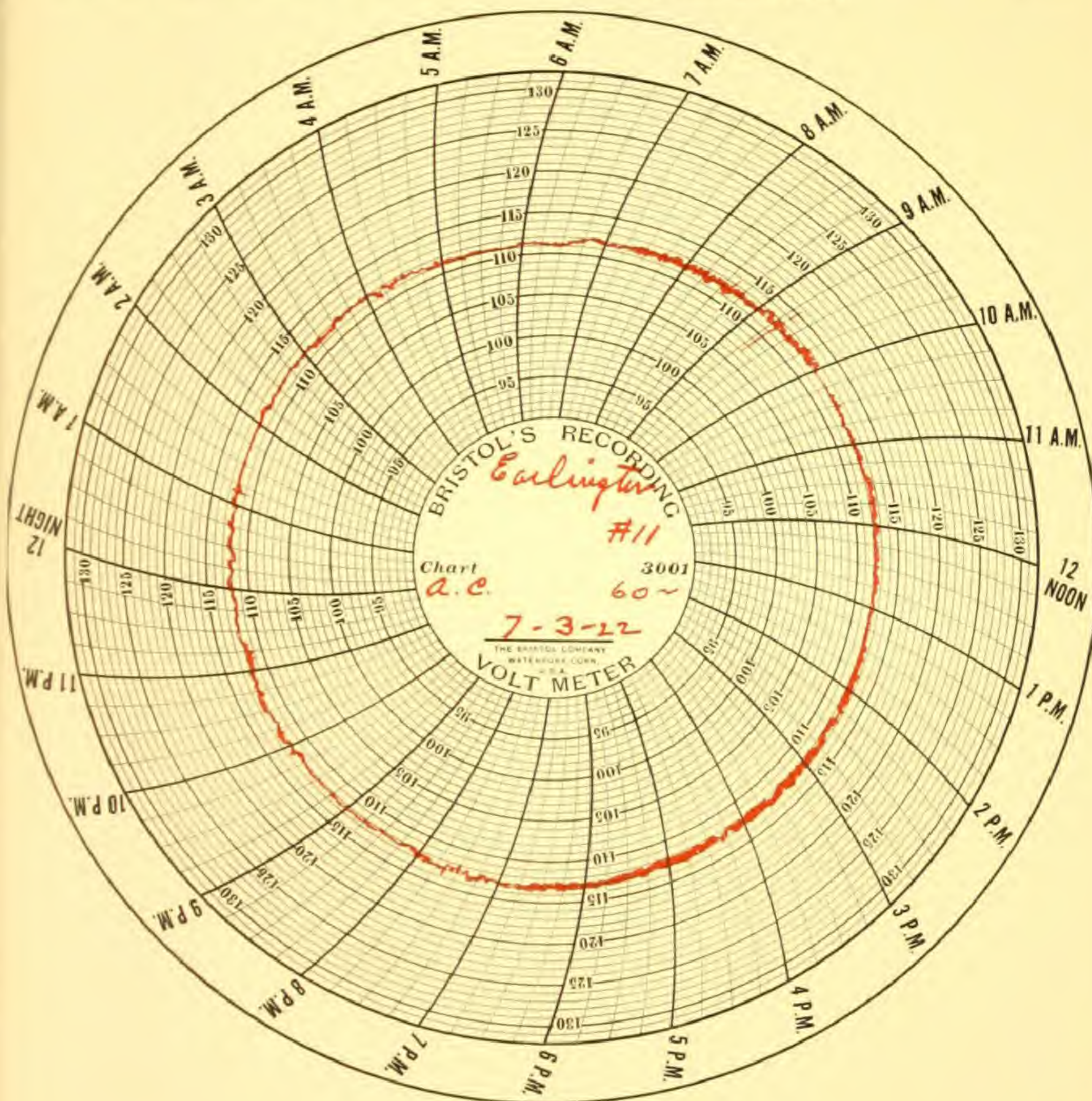


The Bristol's Recording Voltmeters can be furnished to record on round charts or straight ribbon roll or strip chart.

Round chart recording voltmeters are available in two sizes, for use with 8-inch or 6-inch charts.

Reproductions in exact size together with actual records are shown here on pages 2 and 3.

To compare the round chart with strip chart, refer also to page 12, on which is shown section of strip chart with record.



6-INCH ROUND CHART with RECORD

The chart with record shown here was made with Bristol's Recording Voltmeter Model 547. In explaining the use of these instruments the user writes as follows: "The recorders have been installed at various points on our single phase 60 cycle alternating current distribution system for the purpose of checking regulation of voltage, etc., on these lines."



## BRISTOL'S RECORDING VOLTMETERS

From the standpoint of both the electric service company and the user of electric current, a steady voltage is desirable. Fluctuating voltages result in reduced efficiency and effect the speed and the capacity of motors, the brightness of the electric light, and the life of the electrical equipment in general. Bristol's Recording Voltmeters described here are used to furnish a continuous record of fluctuations together with the time at which they occur; and having such information it is possible to correct and smooth out irregularities.

### FOR COMMERCIAL APPLICATIONS

These instruments are designed primarily for general commercial use. However, they can be supplied with specially adjusted movements which also makes them adaptable for laboratory purposes.

### WHERE USED

The following are a few concrete examples of the outstanding applications where recording voltmeters are used to advantage: Transformers on High Voltage Alternating Current System—Recording Primary Voltages with suitable Transformers at Power House—Recording Secondary Voltage at Consumers' Premises—Voltage Output from Emergency Storage Batteries—Incoming Voltages at Manufacturing Plants.

### ROUND or STRIP CHART MODELS

Voltmeter instruments can be furnished to record either on round or strip charts. With the round chart the record is supplied for a complete cycle of time, 24-hours, etc., and thus the entire record is easily visible at a glance. In contrast, a continuous record over a period of several weeks is provided by the strip chart model. Each type of instrument has particular advantages for certain requirements, and should be selected with the idea of the instrument best adapted for the work in hand.

Equipped  
Binding Po  
Front Conn

This R  
permanent  
Binding pos  
for front co  
when desir  
board panel





## RECORDING VOLTMETER MODEL 511



Equipped with Binding Posts for Front Connection.



Side View of Model 511 showing Terminals for Back Connection.

This Recording Voltmeter is intended for permanent mounting on wall or switchboard. Binding posts on the bottom of case are furnished for front connection, but terminals on the back when desired to make connection through switchboard panel.

The instrument is furnished in one size using 8-inch round charts having increasing or uniform scale graduations, and having time divisions to use with clock for making one complete revolution in 24-hours or 7-days.

The case is aluminum, plain in design and finished in black enamel.

## RECORDING VOLTMETER MODEL 535



The rectangular case provides ample room for the "Law of Squares" movement; but can also be furnished with any of the other movements when desired. It is made in one size only, for 8-inch charts.

The case is bronze finished in black enamel with nickel raised parts. It may be had for front connection or equipped with terminals for mounting through switchboard panel.



## RECORDING VOLTMETER MODEL 547



Equipped with  
Binding Posts for  
Front Connection.



Side View of Model  
547 showing Terminals  
for Back Connection.

This is a small sized recording voltmeter using 6-inch charts only. However, the same high quality of electrical movement is used as in the other Bristol's Voltmeters. Where relative values of voltages are more important than wide open readings, this instrument is in every way a satisfactory equipment.

Like other round chart voltmeters, this model can be furnished with clock to make one complete revolution of chart in 24 hours or 7 days.

The all metal case of aluminum is finished in black enamel. It is made moisture-proof and dust-proof by suitable gaskets, thus giving complete protection to the working parts.

## RECORDING VOLTMETER MODEL 512



Particularly for electric service companies a portable recording voltmeter like that shown here is very useful. It can be easily carried about to obtain voltage records wherever required, on the line, the customer's premises, etc. The case of rectangular shape makes it possible to furnish this instrument with any one of the three types of Bristol's Voltmeter Coils for 8-inch charts.

This portable model can also be furnished in a smaller size to use 6-inch charts having increasing or uniform graduations but not law of squares.

Except for ranges above 750 A. C. this instrument is self contained. The necessary resistance is mounted in the portable case at the right-hand side.



# RECORDING VOLTMETER MOISTURE-PROOF MODEL 555

This shows water-proof case which is recommended for use with Bristol's Recording Voltmeters when they are to be mounted out-of-doors. A case like this gives complete protection from atmospheric conditions.

The particular instrument shown here is that with the 6 inch chart, but similar water-proof case for 8 inch chart can be furnished as required.

The illustration below at right shows the resistance box mounted in water-proof case for out of-door installation.



## RESISTANCE BOX



The necessary resistance is always furnished as a part of the standard equipment with Bristol's Recording Voltmeters. The illustration here shows the type of resistance generally used with instruments for permanent mounting.



The resistance with portable type of instrument is mounted inside the case, as shown in the illustration on page 6.



### RANGE

The Round Chart Models of Recording Voltmeters shown here can be furnished for A. C. or D. C. They are calibrated for all ranges of D. C. as required by commercial practice; but for higher ranges of A. C. they are wound for use with potential transformers and can be used with any standard instrument transformer of the proper ratio. While it is stated instruments can be supplied for either A. C. or D. C., they are not regularly interchangeable, but can be made so by supplying extra binding post.

### OPERATION

The electrical elements used in Bristol's Round Chart Recording Voltmeters are two general kinds. The Moving Iron and Attractive Coil Types.

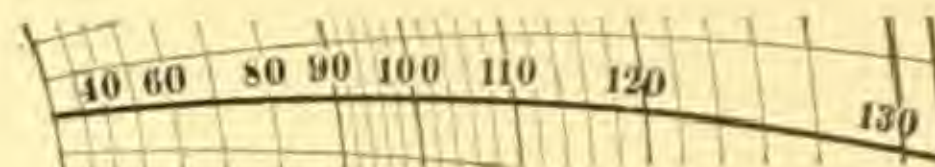
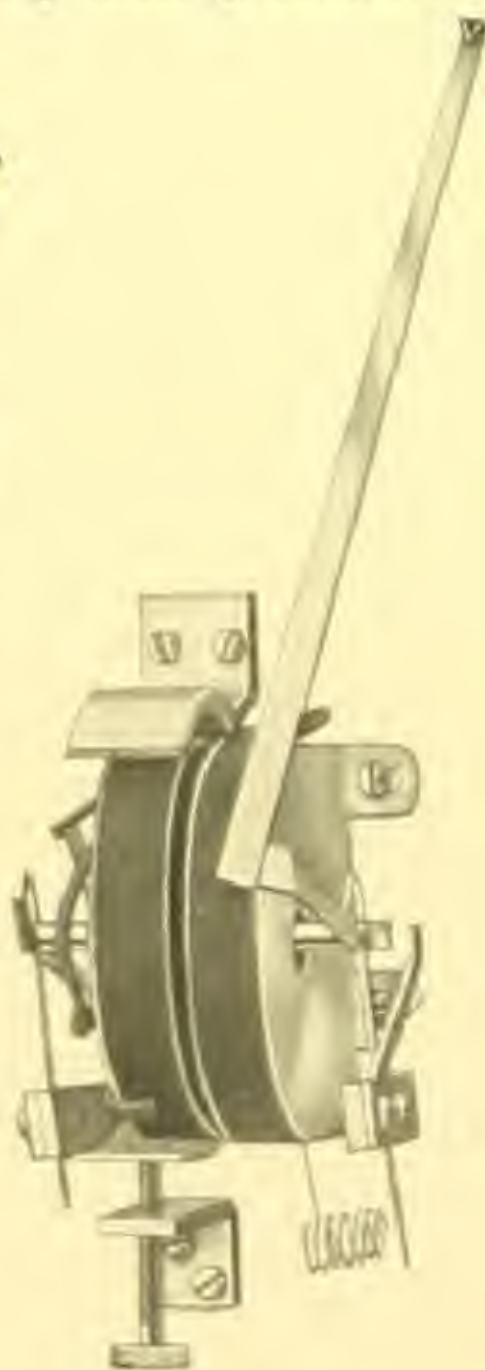
The Moving Iron type of element is further divided into two classes, the Attractive Disc and Soft Iron Plunger.

### CHART CHARACTERISTICS and MOVEMENTS

When Recording Voltmeter is desired with chart having full range scale, but where the working range falls in the higher part of scale and close readings are required only for working range, then the movement using attractive coil is furnished. This is because the chart for "Attractive Coil" movement has increasing scale graduations.

### ATTRACTIVE COIL MOVEMENT

Here is illustrated the attractive coil movement, which produces chart having increasing scale graduations.

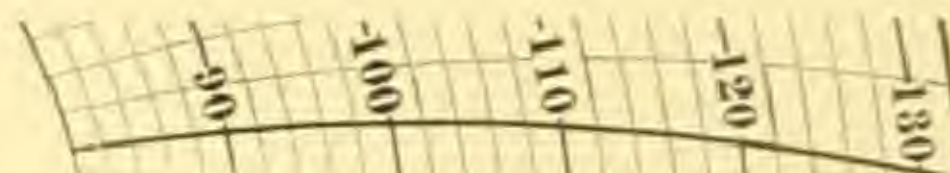


Specimen chart section having increasing scale graduations.

### ATTRACTIVE DISC MOVEMENT

Where it is necessary to have close readings of voltages over the entire chart range, but the range is not necessarily a broad one; for such requirements the "Attractive Disc" movement is used. The chart scale for attractive disc has uniform graduations and furnished in partial or contracted scale ranges.

This is the movement used in Bristol's Recording Voltmeters with charts having uniform graduations.



Section of chart with uniform scale graduations and partial range.



### SOFT IRON PLUNGER TYPE of MOVEMENT

If instrument is wanted with full scale range and fairly open readings over entire range, then "Soft Iron Plunger" type of movement is recommended. This class of movement produces what is known as Law of Squares chart and has an even finer degree of accuracy than the other two types.

Movement known as "Soft Iron Plunger" type which produces the "Law of Squares" chart.

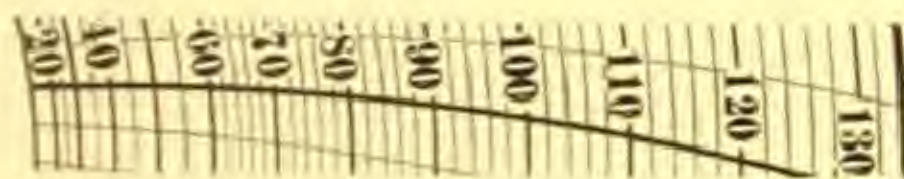
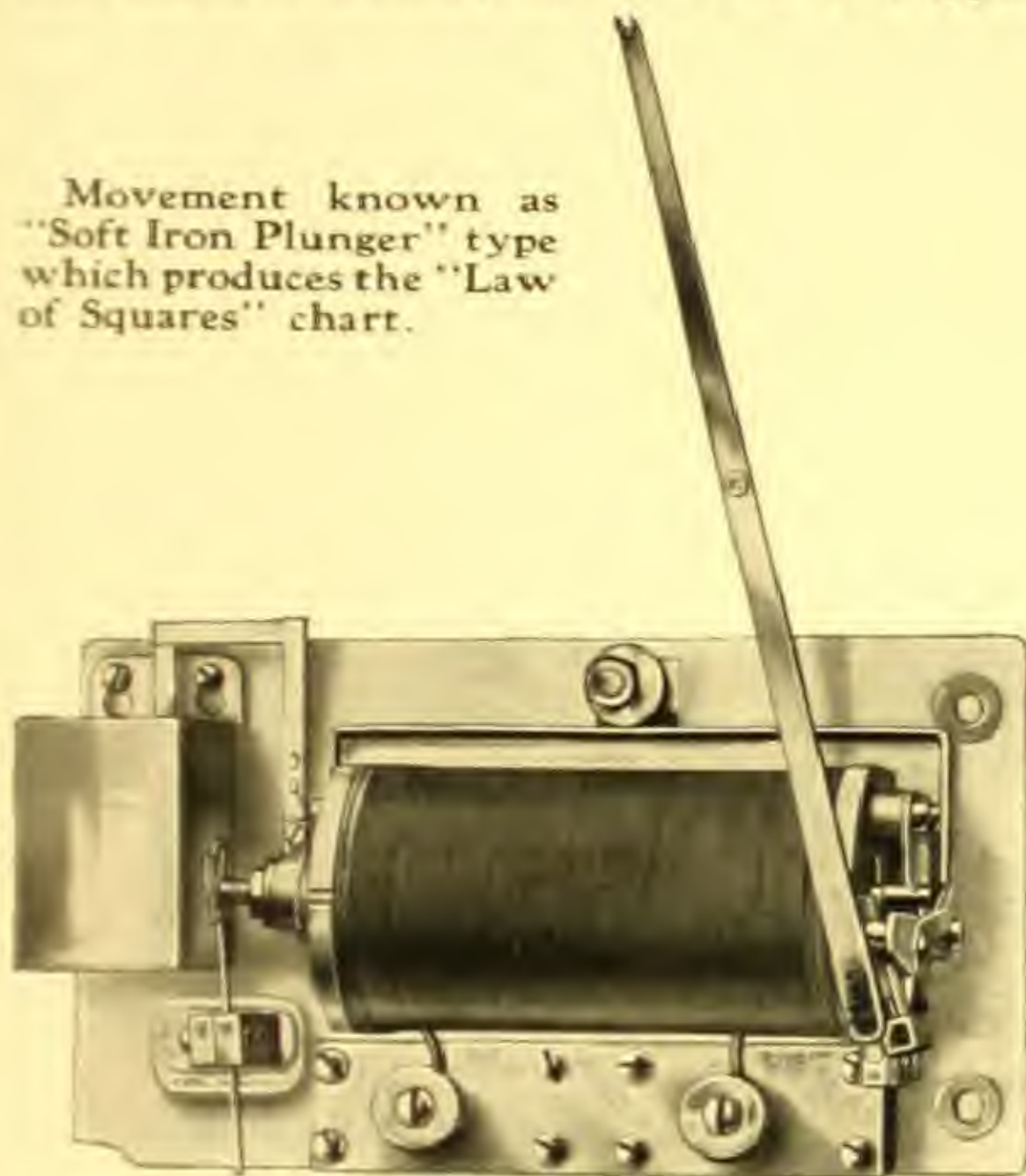


Chart Section having graduations according to "Law of Squares."

### DAMPING DEVICE

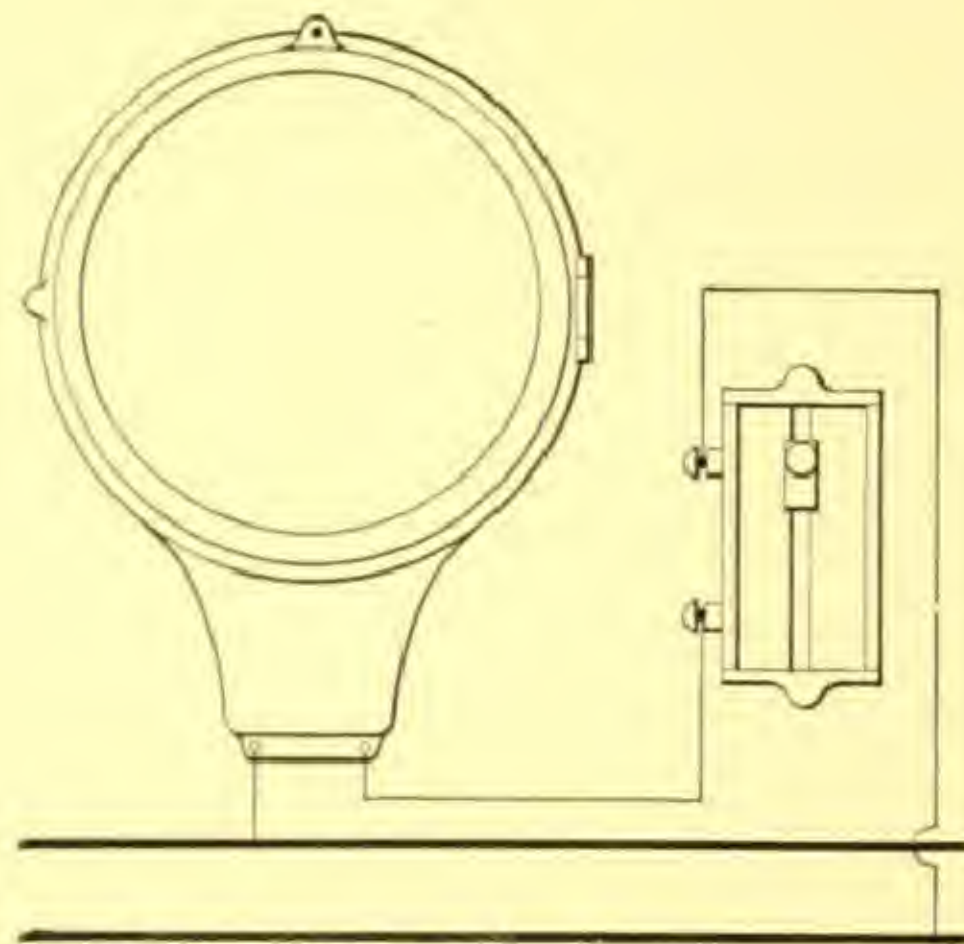
It is not usually necessary to equip recording voltmeters with damping device. But, for installations where severe conditions of rapidly fluctuating voltages are common, an oil damping is furnished. This consists of a vane moving in a container of oil and the degree of damping regulated by grade of oil used. The oil damping device is illustrated in connection with Soft Iron Plunger Type of movement shown above.

### TRANSFORMER

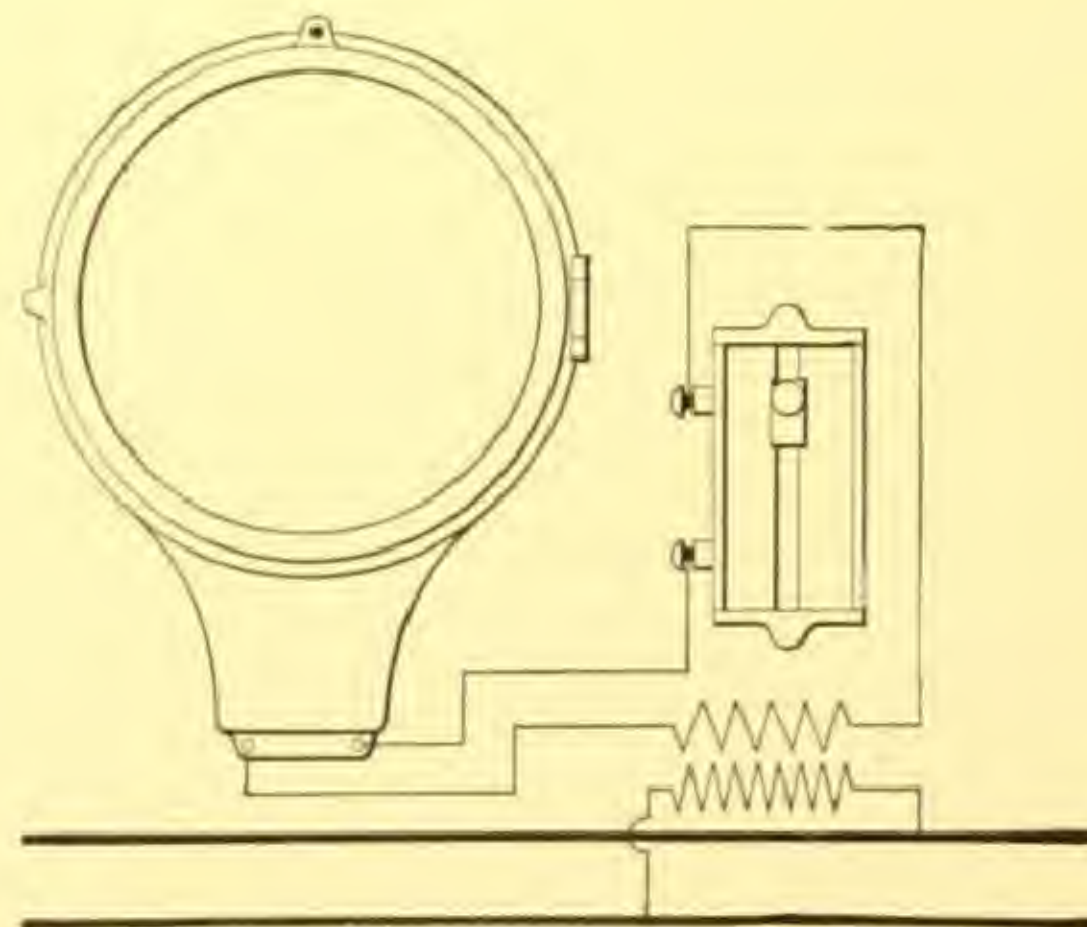
All instruments for high ranges of A. C. should use transformer of proper ratio. When thus equipped the movement is connected to secondary side and wound for whatever value transformer is furnished for.

### CONNECTING VOLTMETER in the LINE

It is an easy matter to install and connect up Bristol's Recording Voltmeters. With the complete instructions furnished with each instrument, this can be done by anyone having rudimentary electrical knowledge, or the "handy man" usually found in every organization. The diagrams below show the general methods which apply in connecting voltmeters into the line.



Method of connecting Voltmeter for D. C.



Method of connecting Voltmeter for A. C.

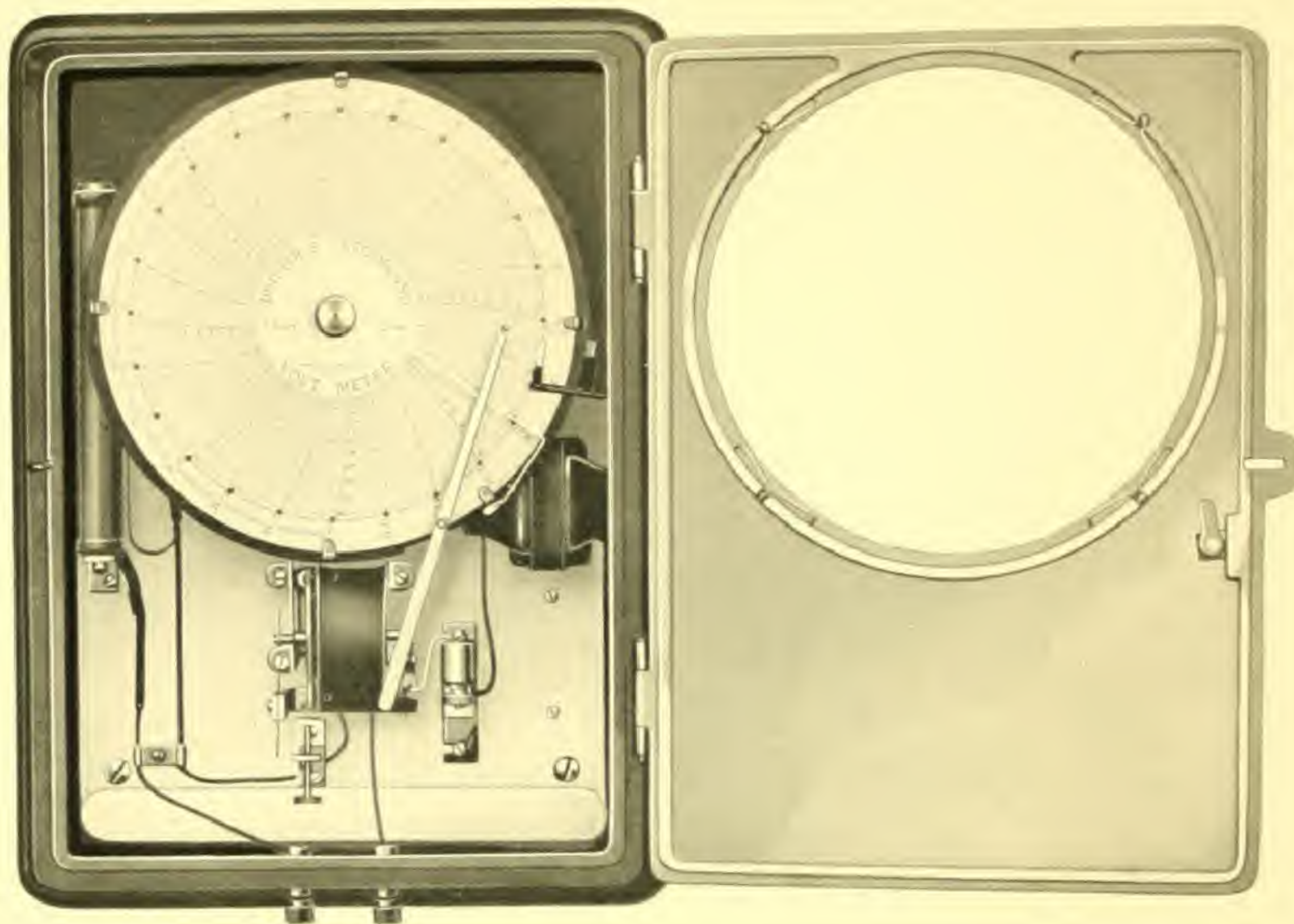
MOTION, ETC.

MOTION, ETC.



## HIGH-SPEED CONTACT-MAKING RECORDING VOLTMETER

### USED FOR WIDE OPEN RECORDS OF VOLTAGE DISTURBANCES



The purpose of this Voltmeter is to give a detailed record of line voltage on a fast moving chart.

It is so designed that the instrument only operates during line disturbances that cause the voltage to drop below normal (or predetermined point). At other times the instrument is not recording although it is connected to the system.

This instrument does not show at what time the low voltage starts. Such information is supplied by the other Recording Voltmeters having daily or weekly charts. The Contact-Making Voltmeter only records the exact disturbances during the period after low voltage or what fluctuations occurred during this period. Of course, the regular Recording Voltmeter will show this, but if the disturbance only lasts a very short time, the time interval on a daily or weekly chart is so small that it is very difficult to read, thus the uses of the Contact-Making Voltmeter is apparent.

The instrument consists of a Model 535 Bristol's Recording Voltmeter movement, with a contact-making device, a 15-minute clock with relay, the armature of which controls clock, and a time period contact on the dial. A smoked type of chart is recommended for use with this instrument, as ink in a recording pen may dry during periods of inoperation and the value of the record would be lost.

The instrument is entirely self-contained, two wires only are needed to connect line, no separate source of supply or contacting device is necessary. It is simple in construction, yet flexible enough to meet every requirement.

The Voltmeter element is calibrated to a Law of Squares chart which gives a better record for that part of scale mostly used, and operates on minimum power with maximum movement strength. A mercury contact is used that can be

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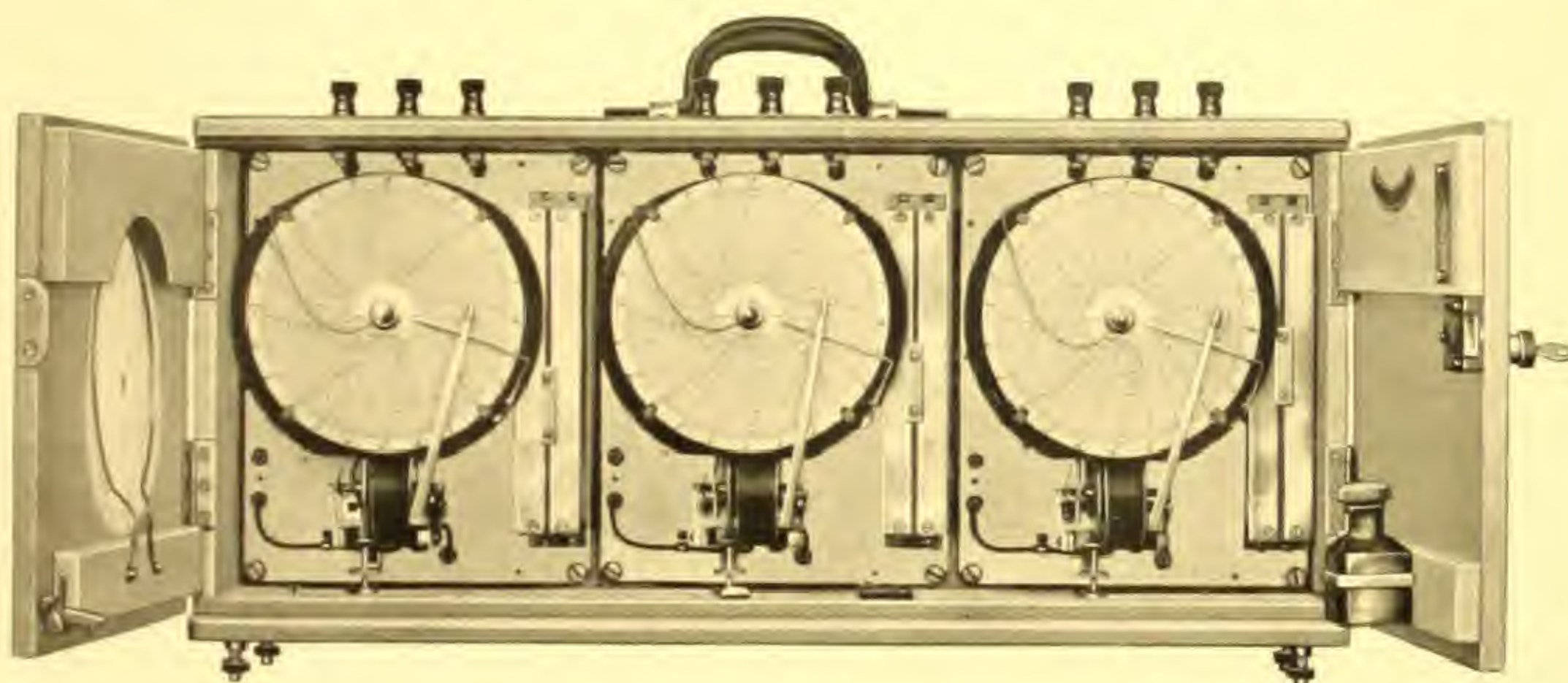
set at any point on the scale where it is desired to start the record, and offers no resistance to the movement so that the readings are equally accurate at all points on the chart. The movement resistance is fixed. The pointer may be adjusted when checking.

A Bristol 15-minute clock is used in connection with relay for starting and stopping, which is entirely self-contained. The relay armature when closed stops the clock by holding balance wheel in such a position that when it is released it is absolutely positive in starting. To control the time period of contact, a spring contact is used

which rests on the chart, making contact with the dial through holes in the chart. The distance between these holes determines the time or operation of the chart, and may be varied as desired by the user.

To supply power for the contact making device, a small transformer is used so that same operates on a low voltage. This eliminates any possibility of sparking at contacts and simplifies the contact device. The primary of this transformer is connected in parallel with the Voltmeter movement so that no added connections are necessary in putting the Voltmeter in operation.

### THREE-PHASE RECORDING VOLTMETER



This equipment includes three Bristol's Recording Voltmeter Movements mounted side by side, which offers a most convenient arrangement for obtaining continuous and simultaneous records of three-phase circuit. A single instrument, or even two would not give true comparison, as readings would necessarily have to be taken on different days and with probable varying load conditions.

Illustration shows three external binding posts for each movement. Similar equipment can be furnished with individual set for each instrument, but mounted on inside of case and having inside wiring connections made to one set of external binding posts. So arranged it is a very easy matter to set up the equipment out in the field—

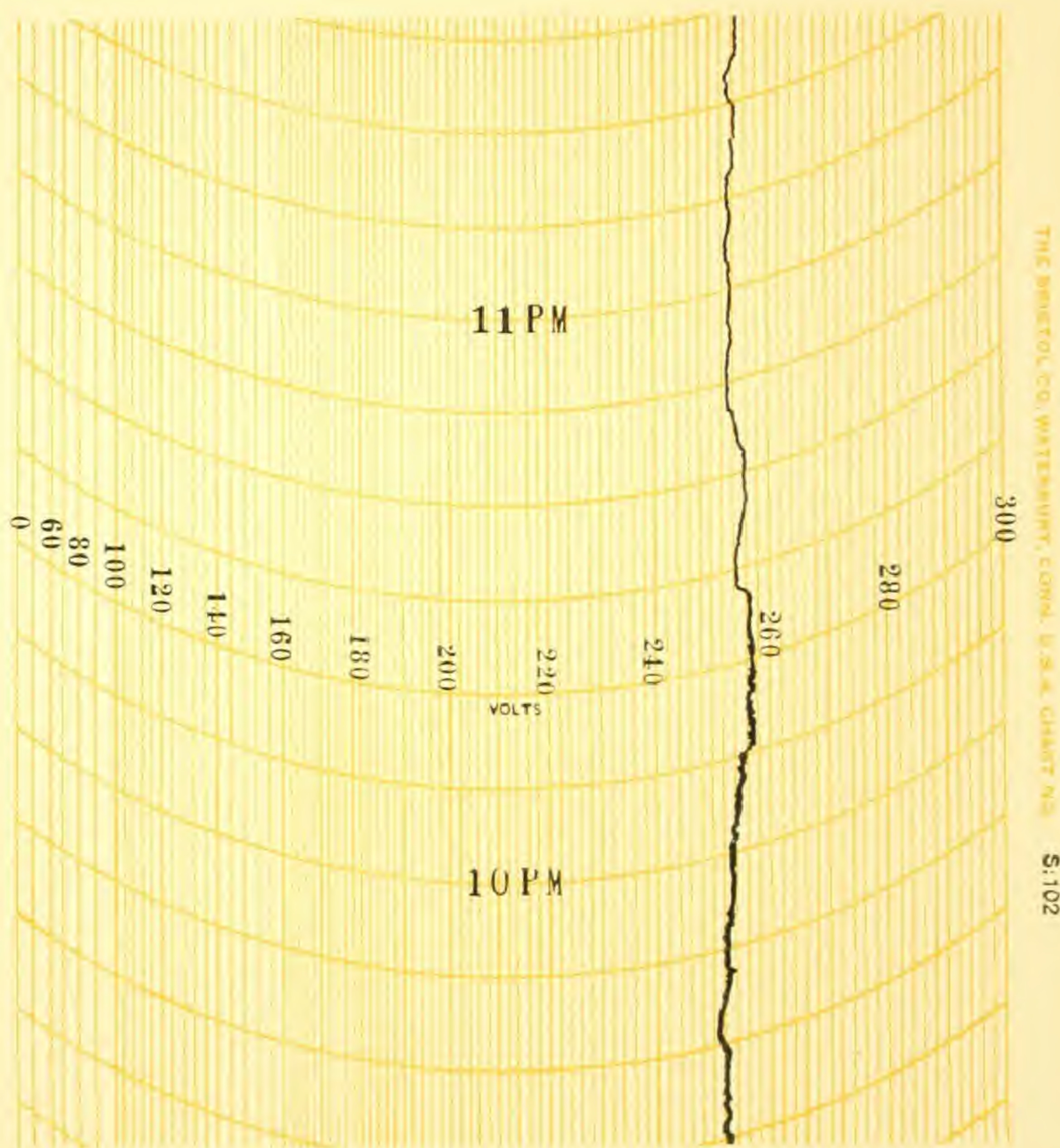
simply run leads from the external binding posts to the line.

When desired, instruments can be furnished to use with more than one frequency; for example, 25 and 60 cycles. Also instrument can be calibrated for a second range, which may be for A. C. or D. C. as desired. In either case, the third binding post is utilized.

Still another use for this combination is to furnish record of voltage for three single-phase circuits.

The case in which the voltmeter movements are mounted is made of wood and stained walnut. The complete outfit is very light in weight and easily carried by one person.



**STRIP CHART RECORDING VOLTMETERS**

Above is a small section taken from complete Strip Voltmeter Chart, which is 90-feet long. The instrument is installed on the feeder panel supplying large industrial plant.

With a chart record like this, there is no opportunity for dispute between company furnishing power and the user.

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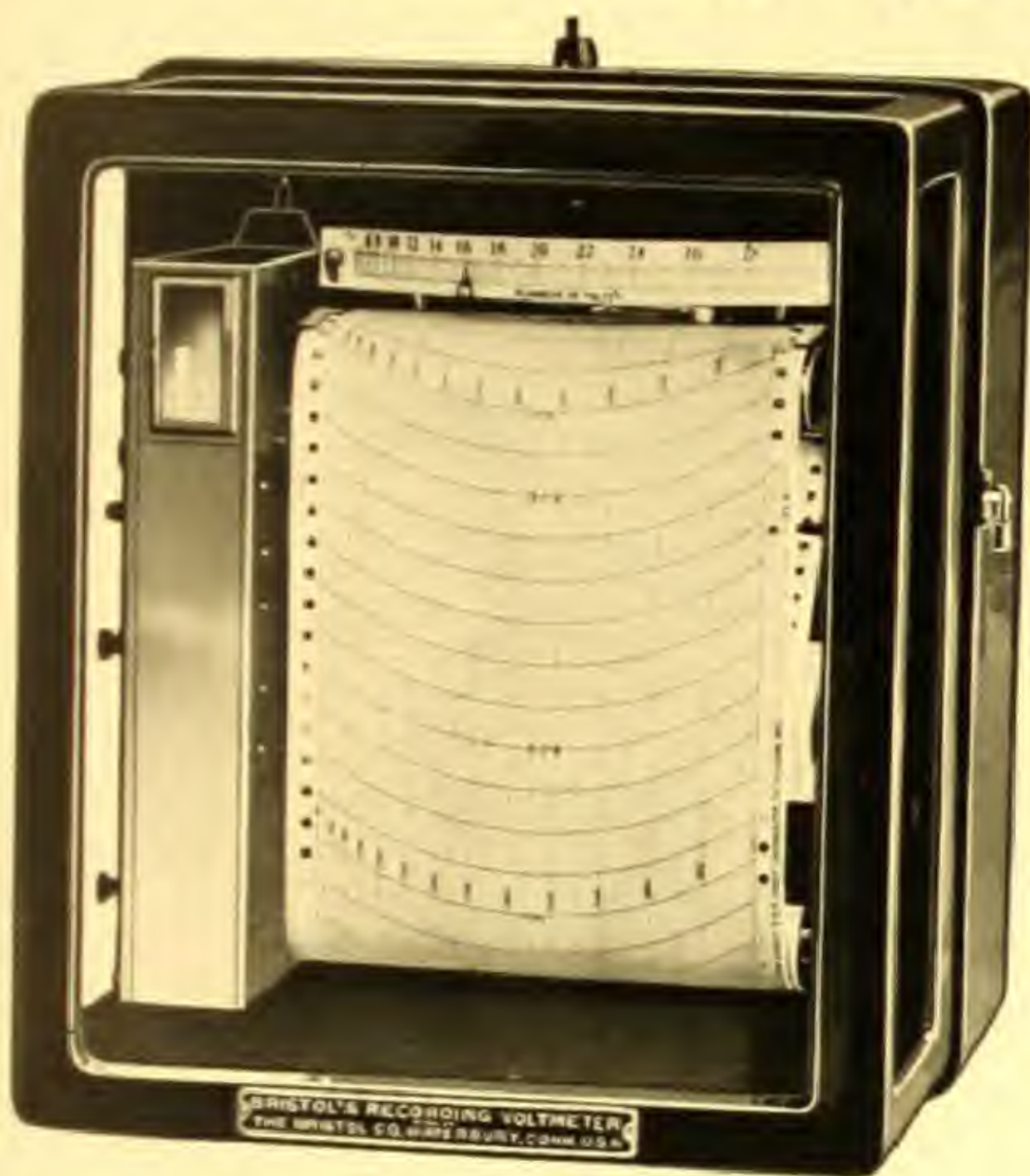
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## STRIP CHART RECORDING VOLTMETERS



Model 525 for Permanent Mounting

This instrument operates on the same general principle as the voltmeters described in the first part of catalog, but instead of using round chart, the records are made on a straight ribbon roll or strip chart.

## LONG CONTINUOUS RECORD

Unbroken records of voltages over a period of time including 45, 30 or 15-days is furnished by the strip chart recording voltmeter.

## CLOSE ACCURACY in READING

The open scale is a characteristic of the strip chart, and recommends the instrument for use where close accuracy in reading details is desired.

## CHARTS

The full width of the chart is 6-inches with actual scale of  $5\frac{1}{4}$ -inches. They are furnished in rolls 90-feet long.

As will be noted in the specimen chart on page 12, the scale markings are in orange color, with figures for time arcs and main scale divisions in

black. This background and the black record provides a very distinctive combination so that the record line and its values are easily read.

The chart is furnished on a stock roll and inserted in the instrument in this form. From the stock roll it passes over the chart roll, which is operated by the clock and controls the speed of the chart. Lastly the chart goes to the rewind roll, the function of which is to reroll the chart as fast as the record is run off. This rewind roll is operated by a separate spring mechanism.

Using this method, about 8-inches of the chart (or equivalent of 8-hours record at the speed of 1-inch per hour) is visible on the instrument at any one time. When preferred, instead of using the rewind roll the chart may be fed through a slot in the bottom of case so that a greater amount of record is always visible. This last, however, does not apply to the portable model.

In case it is desired to cut off a portion of chart with record soon after it is run, a stripper roll can be supplied which serves to keep the remaining chart taut. This makes it possible to chop off the chart periodically to include record within about 1-hour previous.

DIRECT MARKING  
INK RECORDING SYSTEM

The penarm is mounted above the chart and consists partly of a fine hollow tube with extension projecting downward to the ink reservoir, the other end just resting on the chart. In operation the ink siphons to the recording tip where capillary attraction causes the record to be made.

It is essential that all possible friction be eliminated in recording, and for this purpose the recording arm is equipped with a threaded end on which is mounted a balance screw. This provides an adjustment so close that the pointer may barely touch the surface of the chart.

One filling of the ink reservoir is generally sufficient to last for one winding of the clock. This applies except in very unusual operating conditions. When the chart is operated at the speeds of 1-inch, 3-inches or 6-inches per hour, the clock requires winding once every 7-days. When operated at faster speeds it is necessary to wind the clock more often. The standard recording ink furnished with Bristol's Strip Chart Instruments is black.



## STRIP CHART RECORDING VOLTMETERS

### PERMANENT INDICATING SCALE

In addition to the charts on recording system, each instrument is equipped with permanent scale and pointer. The pointer is part of the recording penarm and indicates continuously the voltage as it is recorded. Such a pointer serves as a convenient spotter and makes it easy to read the voltage being recorded, even at some distance from the instrument.

### RANGE

The strip chart voltmeter is furnished as required to take care of all commercial ranges including both A. C. and D. C.

### ELECTRICAL MOVEMENT and CHART SCALE

Two types of electrical movements have been selected as best suited to take care of the variety of work required for the strip chart voltmeter. These include dynamometer and Weston. The application of instrument determines the selection.

For alternating current the dynamometer movement has proven the one best adapted. In fact, an accuracy of  $1\frac{1}{2}\%$  or better, of total scale range is usual with this movement.

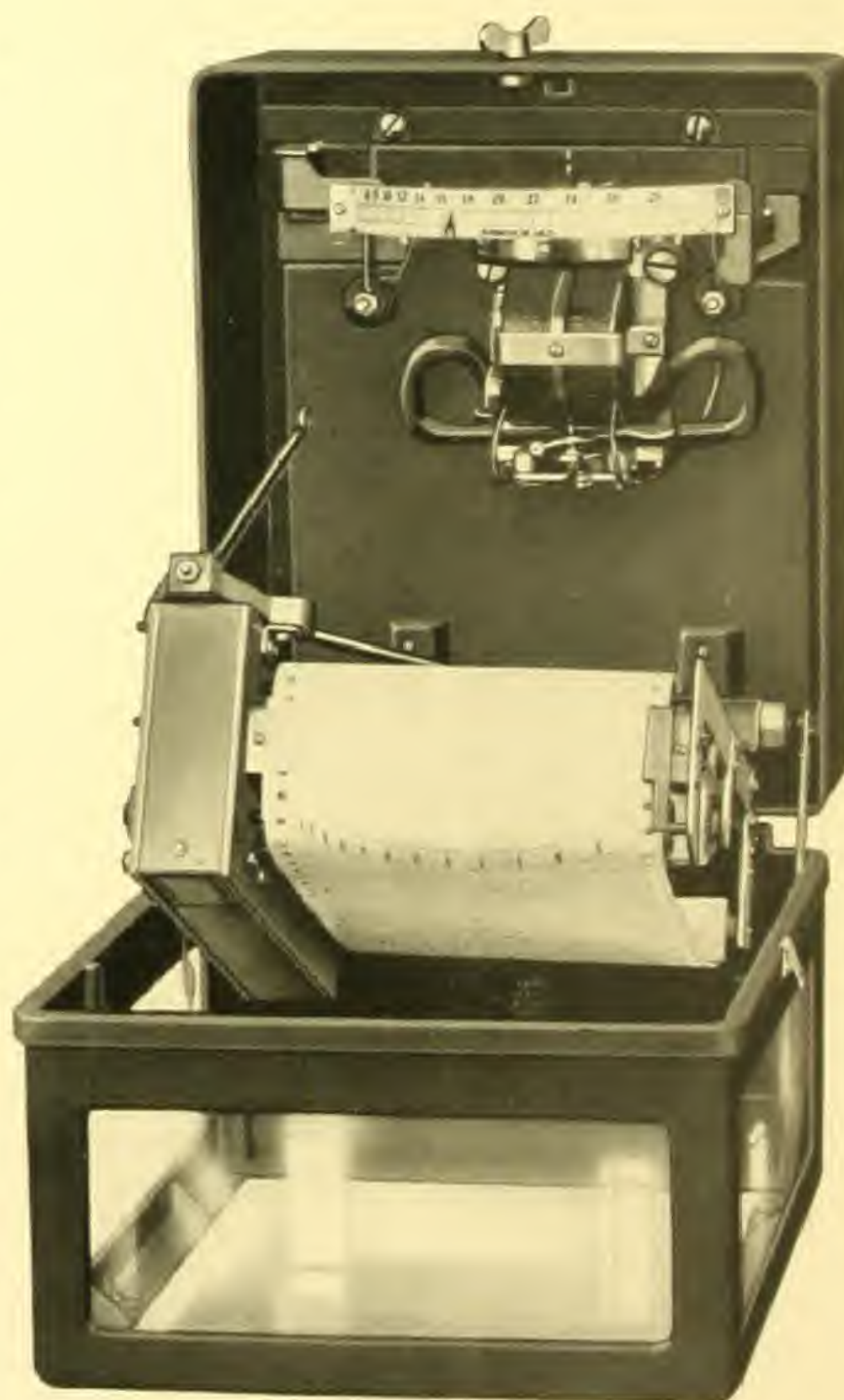
The charts with dynamometer movement are increasing according to law of squares, and are selected for use so that the operating range falls within the more open scale portions. This provides a clear, open, easy-to-read record. For example, chart with range of 0-150 volts, the more open scale occurs at about 110 and 125 which is a very common operating range.

The dynamometer movement is not confined exclusively for use with alternating current, but may also be used on direct current when the law of squares chart is desired. When used for D. C. the dynamometer movement will average an accuracy of 2 to  $2\frac{1}{2}\%$  total scale range.

The electrical movement generally recommended for direct current is the "Weston," which operates

on the D'Arsonval principle, but revised to make it suitable for commercial purposes. Among the changes is the elimination of delicate suspensions and the substitution of double pivots. For direct current this movement will give an accuracy of  $1\frac{1}{2}\%$  or better, over full scale range.

The chart scale with "Weston" movement is uniform over the entire range and thus lends itself for both full and partial scale ranges.

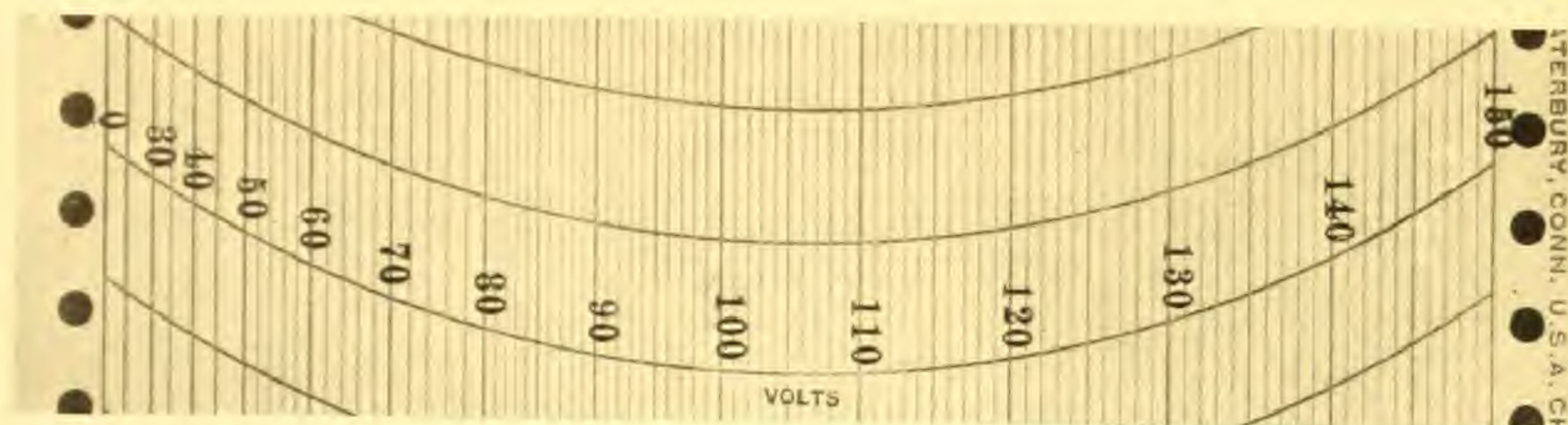


Voltmeter Model 525  
showing Interior Construction

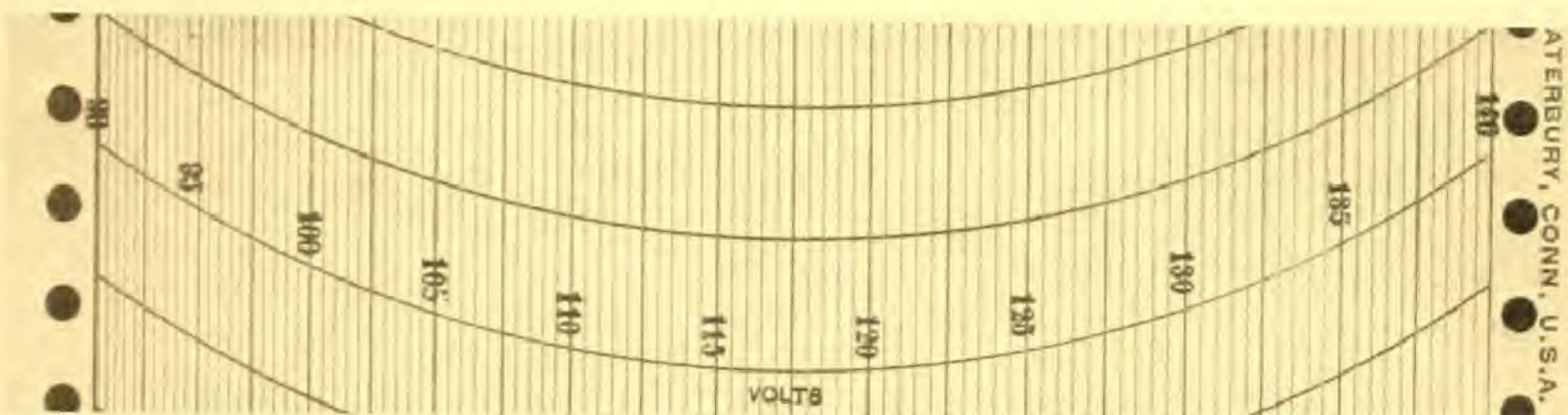
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# STRIP CHART RECORDING VOLTMETERS



Section of chart having increasing scale according to Law of Squares, as used with Dynamometer Movement.



Partial scale range chart for Dynamometer Movement.

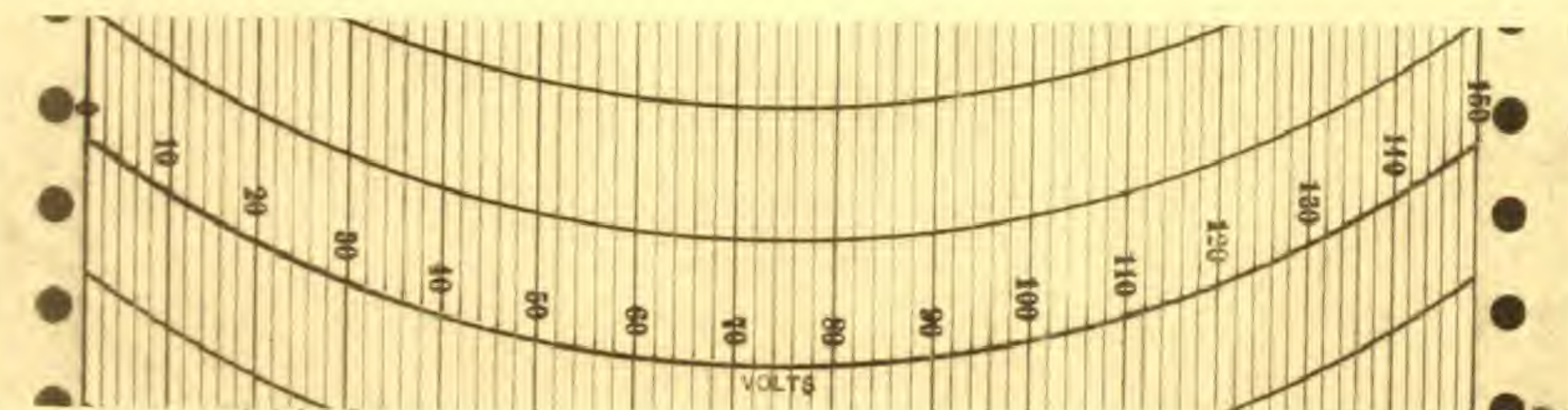


Chart for D'Arsonval Movement showing the characteristic uniform scale over complete range.

## CLOCK

A heavy duty clock especially designed for the work is furnished in the strip chart instrument. Its function is to drive the chart roll, and in doing

this, it also serves to control the chart speed. Because time arcs are marked off on the chart, it is thus possible to know at what time any voltage conditions take place.

MOTION, ETC.



## STRIP CHART RECORDING VOLTMETERS

The standard clock speeds are 1, 3, and 6-inches per hour. A change from one to another speed can be made by a simple substitution of gears. Each set of gears are mounted on a plate, and it is only necessary to remove two screws to make the change. Three sets of gears are standard equipment with each instrument. Furthermore, by the simple shifting of a lever, faster speeds of 1, 3, and 6-inches per minute may be had, depending upon the gears in position.

When desired, a motor operated clock can be furnished in place of the spring wound type. For more complete description of this, see page 20.

### INSTRUMENT CASES ADAPTED to WORK in HAND

The type of case housing the movement has an important part in adapting the instrument to the particular work required. Bristol's Recording Strip Chart Voltmeters are furnished in cases suitable for mounting on switchboard or wall, also in portable model for carrying about.

These cases are made of all metal (iron or aluminum) and glass, sufficiently rigid to amply support the movement and prevent any possibility of getting out of alignment. They are dust-proof in construction, and not only completely protect the movement, but are sufficiently rugged to stand up for a period of many years even though exposed to fairly severe conditions. A properly constructed case materially keeps down the cost of maintenance.

The finish of the case is high grade black enamel.

### SWITCHBOARD MODEL

The instrument illustrated on pages 13 and 14 is Model 525 designed for installing on switchboard, and having the supports and electrical connections at the back so that when mounted the connections do not show.

### WALL TYPE

Differing from the illustration, the wall type strip chart recording voltmeter is equipped with three lugs for supporting the instrument, and the electrical connections are made by suitable

binding posts at the side. Such instruments may be mounted at any convenient place on wall, post, etc., for easy observation. Some of the uses are for permanent installation at main generating or automatic substations. Also on premises of large users to check incoming line voltages on power or lighting circuits.

### PORTABLE MODEL

The movement in the portable voltmeter is same as that used in models for permanent installation. The all metal case, which is aluminum, supplies the necessary rigidity required for instrument of precision. At the same time, it is light in weight, a desirable feature for portable purposes. The finish is black enamel. A leather handle is provided for convenience in carrying.

The base is provided with adjustable leveling screws. However, the instrument is so designed that it is not essential to use extreme care in adjusting to level.

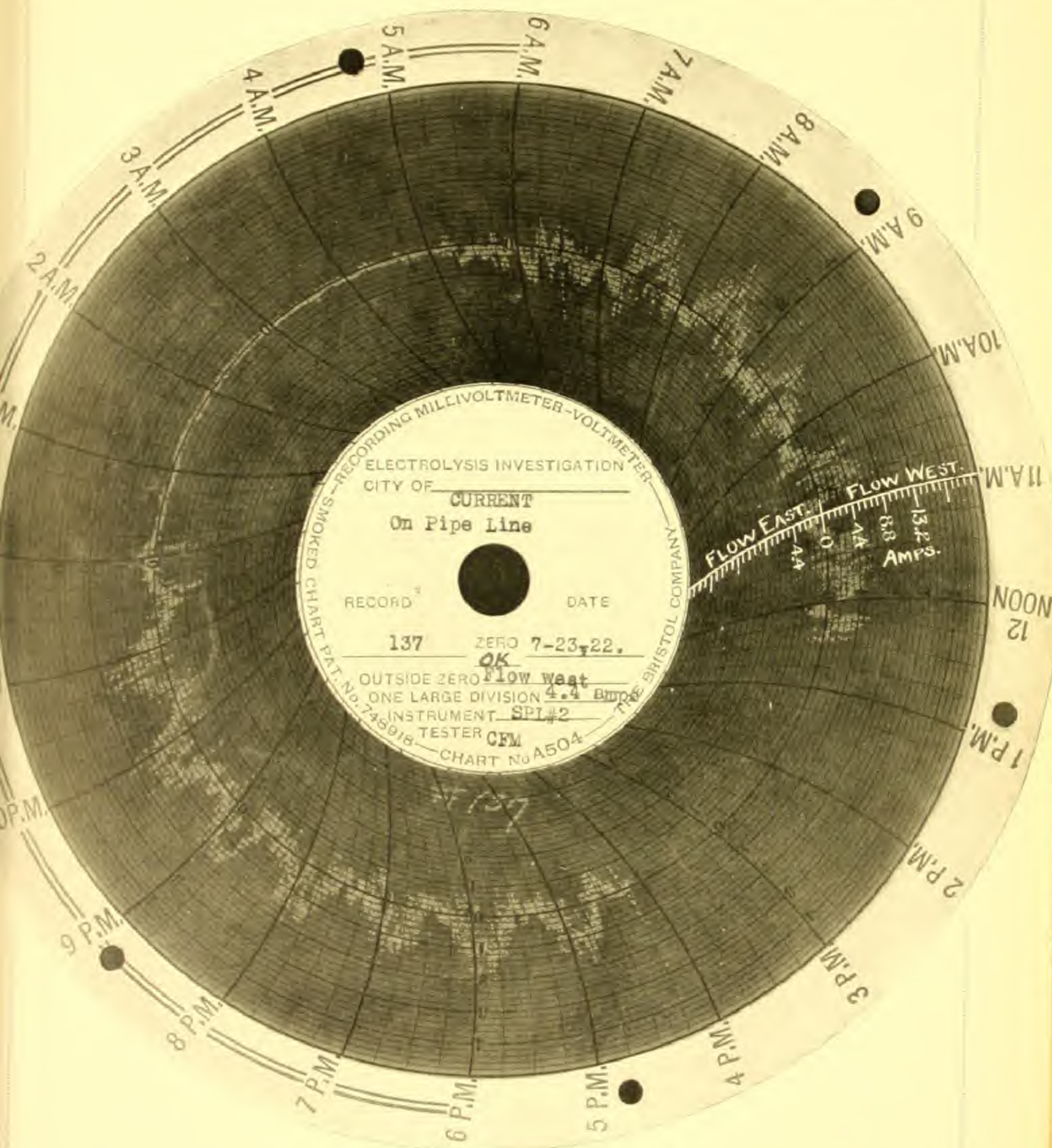
This instrument is a complete unit in itself, including necessary external resistance, which is attached permanently to the outside back of case, except for unusually high voltage. This is an especially important item for portable instrument, as it eliminates the necessity of making a special record of the resistance box in the laboratory, and checking these each time the instrument is to be used.

A portable recording voltmeter like this is particularly serviceable for locating extreme voltage drop or fluctuating voltages when analyzing load conditions for establishing rates, and any other services of a similar nature.



Portable  
Model 526





RECORDING MILLI-VOLTMETER CHART

Full sized reproduction of chart with record, made by Bristol's Recording Milli-Voltmeter, Portable Model 514. This is only one of many charts taken from the files of a complete electrolysis survey.

MOTION, ETC.





## RECORDING MILLI-VOLTMETERS

For recording low voltages of less than one volt, the recording milli-voltmeter described here is specially designed. Such an instrument is particularly desirable for use in making electrolysis tests and recording resistance drop.

### ELECTRICAL MOVEMENT

A direct current electrical movement is used in Bristol's Recording Milli-Voltmeter, which is of the improved D'Arsonval type, "Weston" model.

### RANGE

This milli-voltmeter instrument may be furnished calibrated for ranges as low as minus five to plus five milli-volts, and to include higher range as required.

As many as eight different ranges may be had with one instrument. In providing these additional ranges one chart only is used, and all ranges except the initial one are read by using multiplier.

These several ranges are accomplished by supplying suitable resistances. To change from one range to another, it is only necessary to operate rotary switch which is installed in the upper right-hand corner of the instrument. This switch is shown in the illustration of portable instrument. The above applies to all ranges below 250 volts. On higher ranges an external resistance box is used for the purpose of safety.

### FRICTIONLESS SMOKED CHART RECORDING SYSTEM

The carbon coated chart is employed in recording. With this is used a mechanically vibrated penarm which comes in contact periodically with the sensitized chart surface, and each time leaves a white dot. The result is a succession of dots which is practically a continuous line. On removing, the chart is dipped into a fixative solution which makes the record permanent.

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MODEL 514  
For Portable Use



MODEL 537  
For Permanent Mounting

This method of recording eliminates any possible friction between pen and chart. It is an essential feature—any other system using considerable electric power would necessarily interfere with the accuracy.

## CLOCK

The clock movement is employed to revolve the chart and to periodically press the penarm against the chart.

The clock used is equipped to provide two speeds—to change from one to the other, it is only necessary to turn an arbor with the clock key.

The standard speeds are 24-hour and 1-hour, 24-hour and 6-hour. Others can be furnished if required. The faster speed of clock, of course, gives a more open record on the chart, which is often a desirable feature when running special tests.

When the clock is operated at the 24-hour speed the penarm is brought in contact with the chart every five seconds. On changing to the faster speeds, an extra mechanical vibrator is automatically brought into use which speeds up the vibration of the penarm against the chart in proportion to the speed with which the chart is revolved.



Front View



Back View

MODEL 526  
Portable Strip Chart Milli-Voltmeter



## THE CLOCK USED WITH BRISTOL'S RECORDERS

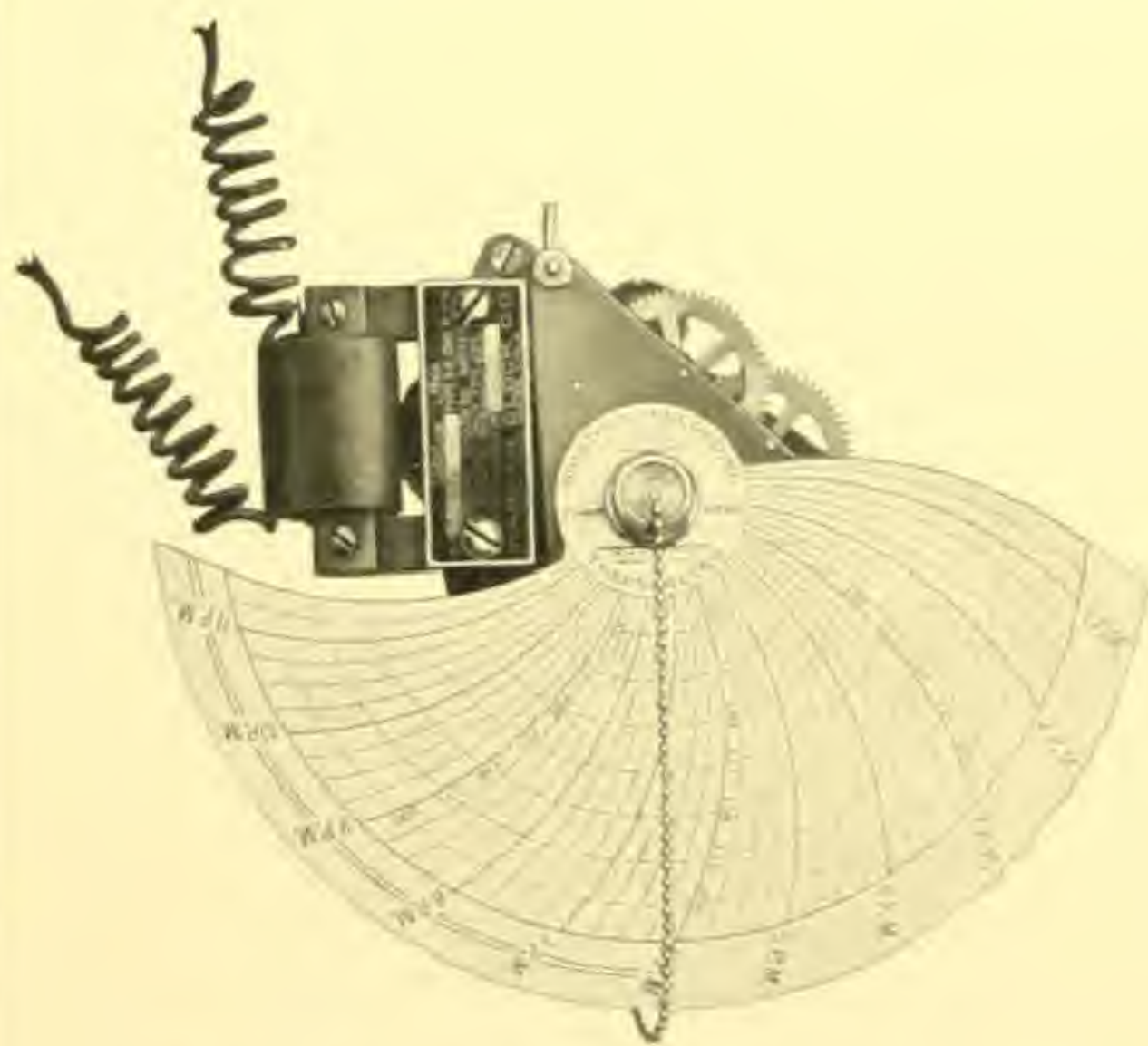
While the penarm is recording on the chart, a clock movement is used to revolve the chart so that not only the voltages can be read but the time at which they occur is also shown.

### SPRING WOUND CLOCK

The clock regularly furnished with Bristol's Recorders is of the spring wound type, specially designed for the work. It is rarely that these clocks fail to operate except for very unusual causes. In such instances they can be easily removed from the case and returned for replacement or repair.

### MOTOR OPERATED CLOCKS

In place of the spring wound clock, Bristol's Voltmeters can be furnished equipped with electrically operated clock. This not only eliminates the necessity for winding, but when several recorders are used equipped with the electric clocks, it is possible to have all charts operating in unison.



Motor Operated Clock used with Round Chart Instruments. This clock can be furnished for 24-hour or 7-day revolutions.

The electric clock furnished with Bristol's Recorders is the Warren Motor Clock. It operates on alternating current where frequency is known to be constant or where power system has synchronous frequency. It can be furnished to use for 60, 50, 40 or 25 cycles.



For use with Strip Chart Instruments the motor operated clock shown here can be had for 3, 6 or 12-inch per hour speeds.

When electric clock is required, specify voltage and frequency.



## ACCURATE CHARTS NECESSARY

Every Recording Voltmeter and Milli-Voltmeter is calibrated to be used with the particular chart specified. This makes it necessary that every chart must be identical without even the slightest variation, in order to insure accuracy. For this reason, every attention is given to the finest details which make Bristol's charts absolutely accurate and reliable under all conditions.

Even the paper on which Bristol's charts are printed is made specially for the purpose. The charts are printed in our own plant from extremely accurate engravings, and under uniform humidity conditions.

The accuracy of Bristol's Recording Instruments cannot be guaranteed unless genuine Bristol's Charts are used. To identify them, every round chart is printed on paper having water mark reading "Bristol's" and the name of The Bristol Company printed in the center; all strip charts have "The Bristol Company" printed on the side.

## CHART REPLACEMENTS

With every new round chart instrument a supply of one hundred charts is included. Additional replacements may be obtained at any time. When ordering specify chart number and kind of instrument.

For convenience, Bristol's Round Charts for ink recording, are packed in boxes containing one hundred each. This facilitates delivery, provides an inexpensive means of filing, and insures clean, unmutilated charts.

Smoked (carbon coated) charts are packed in boxes using special separator discs and rings to prevent the sensitized surface from being rubbed off.

New strip chart instruments are furnished with one ninety-foot chart roll. Additional supplies can be furnished as wanted.



Round Charts are packed 100 to the box. Order by the hundred or multiple thereof, as broken lots are not sold.

## ADDITIONAL SUPPLIES

In addition to charts, the other supplies required are: ink for direct marking instruments; fixative solution for smoked charts; and ink ribbons for manifold recording method.



### SPECIAL INK

Each round chart ink recording instrument is furnished with a one-ounce bottle of Bristol's Special Recording Instrument Ink. This ink is specially prepared for the purpose. It is slow drying and, one filling of the standard "V" pen insures a perfect record for twenty-four hours or more. The standard color for round charts is red, for strip charts black, but others can be supplied when desired.



### FIXATIVE SOLUTION

After the smoked (carbon coated) chart has been removed from the instrument it is dipped into a fixative solution thus making the record permanent.

With each new recording instrument using smoked charts a one-quart can of Fixative is included. Further supply may be had at any time.

### INK RIBBONS

For use on strip chart recording instruments, not using direct marking system, ink ribbons are furnished. They are similar to those used on typewriters and the standard color is purple.



## INSTRUCTIONS FOR ORDERING

• • •

When ordering Bristol's Recording Voltmeters and Milli-Voltmeters,  
as far as possible give data detailed below:

1. MODEL. For Permanent Mounting or Portable Use.
2. FINISH. (If other than Standard.)
3. CONNECTIONS. (Front or Back Connection.) Front Connection is generally furnished for Wall Mounting and Back Connection for Switchboard. Front Connection will be furnished unless otherwise specified.
4. CHART.
  - (a) Round or Strip.
  - (b) Minimum, maximum and average operating ranges.
  - (c) Chart Number if possible. See list of charts given on page with list prices.
  - (d) Size of Round Chart, 8-Inch or 6-Inch. (This applies only to Voltmeters. Milli-Voltmeters are not furnished in the 6-Inch size.)
5. KIND OF CURRENT. A. C. or D. C. If for A. C. state frequency in cycles. (This applies to Voltmeters only. Milli-Voltmeters are always D. C. Instruments.)
6. KIND OF MOVEMENT, i. e. Law of Squares, etc. (This applies to Voltmeters only.)
7. CLOCK OR REVOLUTION OF CHART.

ROUND CHART—24-Hour and 7-Day are standard speeds for Voltmeters. Milli-Voltmeters are equipped with two speed clock, 24-Hour, 6-Hour, and 24-Hour, 1-Hour.

STRIP CHART—Clock speed 1, 3 and 6-Inches per hour are standard.
8. LEADS. 15-Feet is the standard length of lead always furnished with Milli-Voltmeter. Other lengths should be specified. (No leads are furnished with Voltmeters.)
9. ACCESSORIES.
  - (a) Extra Binding Posts. State range of each and for what current. (Voltmeter.)
  - (b) State additional ranges required for Milli-Voltmeter. It is possible to furnish 7.
  - (c) Potential Transformers if for high range A. C. for voltages above 750 a transformer is required. State if it is desired to have The Bristol Company furnish the transformer.
  - (d) Damping Device if required.
10. SHIPPING AND BILLING INSTRUCTIONS.



## LIST PRICES

For Use with Catalog No. 1502, Voltmeter Section

### VOLTMETERS

#### ROUND CHART MODELS (Bristol Movement)

Prices given below are for Bristol's Recording Voltmeters having standard finish case and furnished complete with 100 Charts, Bottle of Bristol's Special Recording Instrument Ink, Padlock and Key and necessary External Resistance.

8-INCH CHARTS			LIST PRICES				
Chart No.	Total Scale Volts	One Revolution of Chart	Model 511	Model 535	Model 512	Model 540	Model 555
127	0 to 130	24-Hrs.	\$66.00	\$76.00	\$81.00	\$87.00	\$92.00
138	0 to 150	24-Hrs.					
130	0 to 180	24-Hrs.					
121	0 to 250	24-Hrs.					
118	0 to 300	24-Hrs.					
131	0 to 130	7-Day	70.00	80.00	85.00	91.00	96.00
288	0 to 150	7-Day					
141	0 to 180	7-Day					
299	0 to 250	7-Day					
265	80 to 130	24-Hrs.	72.00	82.00	87.00	93.00	98.00
286	90 to 130	24-Hrs.					
187	90 to 140	24-Hrs.					
297	90 to 160	24-Hrs.					
186	110 to 180	24-Hrs.					
243	190 to 240	24-Hrs.					
230	200 to 280	24-Hrs.					
226	175 to 300	24-Hrs.					
293	90 to 160	7-Day	76.00	86.00	91.00	97.00	102.00
122	0 to 350	24-Hrs.	81.00	91.00	96.00	102.00	107.00
207	0 to 450	24-Hrs.					
221	0 to 500	24-Hrs.					
108	0 to 600	24-Hrs.					
109	0 to 600	12-Hrs.					
134	0 to 650	24-Hrs.					
195	0 to 500	7-Day	85.00	95.00	100.00	106.00	111.00
176	0 to 750	24-Hrs.	87.00	97.00	102.00	108.00	113.00
199	400 to 750	24-Hrs.	93.00	103.00	108.00	114.00	119.00
Charts graduated according to "LAW OF SQUARES"							
7500	0 to 130	24-Hrs.	—	82.00	87.00	93.00	98.00
7501	0 to 250	24-Hrs.					
7502	0 to 500	24-Hrs.	—	97.00	102.00	108.00	113.00
7503	0 to 750	24-Hrs.					
6-INCH CHARTS			Model 547	Model 516	Model 540	Model 555	
3500	0 to 130	24-Hrs.	\$44.00	\$59.00	\$65.00	\$70.00	—
3501	0 to 150	24-Hrs.					
3067	0 to 200	24-Hrs.					
3054	0 to 250	24-Hrs.					
3061	0 to 300	24-Hrs.					
3001	90 to 130	24-Hrs.	50.00	65.00	71.00	76.00	—
3019	180 to 260	24-Hrs.					
3056	0 to 500	24-Hrs.	59.00	74.00	80.00	85.00	—
3069	0 to 600	24-Hrs.					

Damping device except law of squares movement, \$7.00 extra. Extra tap for additional frequency or D. C. adjustment, \$5.00 each. Extra ranges for double or triple initial range 300 volts and under, \$10.00 each. Extra range for double or triple initial range 300 volts and over, \$15.00 each. Prices for transformers quoted on request.

MOTION, ETC.



### STRIP CHART MODELS (Weston Movement Vibrator Type)

Prices given below are for Bristol's Recording Milli-Voltmeters having Black Finish Case, furnished complete with one 90-Foot Strip Chart, 15-Foot Length of Flexible Copper Lead with Terminals, Ink Ribbon, Clock Key, Padlock and Key.

Chart No.	Range Milli-Volts	Clock Speed per Hour	Model 525 Switchboard	Model 526 Portable
S-518	10-0-10	1-Inch	\$255.00	\$255.00
S-502	10-0-10	3-Inches		
S-513	0-50	3-Inches	250.00	250.00
S-505	0-100	3-Inches		

Prices on Shunts to enable use as Shunt Ammeters quoted on request.  
Extra ranges quoted on request.

### CHARTS

#### ROUND CHARTS

Smoked (Carbon Coated), for use with Bristol's Recording Milli-Voltmeters, size 8-Inch Diameter, per 100	\$2.75
Ink Recording, for use with Bristol's Recording Voltmeters, size 8-Inch and 6-Inch Diameter, per 100	.80

#### STRIP CHARTS

For use with Bristol's Recording Voltmeters, Direct Marking, per Roll 90-Foot long	1.10
Manifold Recording, for use with Milli-Voltmeter, per Roll 90-Foot Long	1.50

### INK

#### BRISTOL'S SPECIAL RECORDING INSTRUMENT INK

One-ounce Bottle	.30
Two-ounce Bottle	.45
Four-ounce Bottle	.65
Half-pint Bottle	1.10
Pint Bottle	1.90
Quart Bottle	3.30
Combination Rubber Stopper and Glass Filler	.11

### RECORD RIBBON

#### RIBBON FOR STRIP CHART

Single Color Ribbon for use with Recording Milli-Voltmeter—if not otherwise specified purple color will be furnished, each	.45
----------------------------------------------------------------------------------------------------------------------------	-----

### FIXATIVE

#### FIXATIVE FOR SMOKED CHARTS

Fixative Solution, per quart can	.80
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### CHART HOLDER

#### CHART HOLDER FOR WALL OR SHELF USE

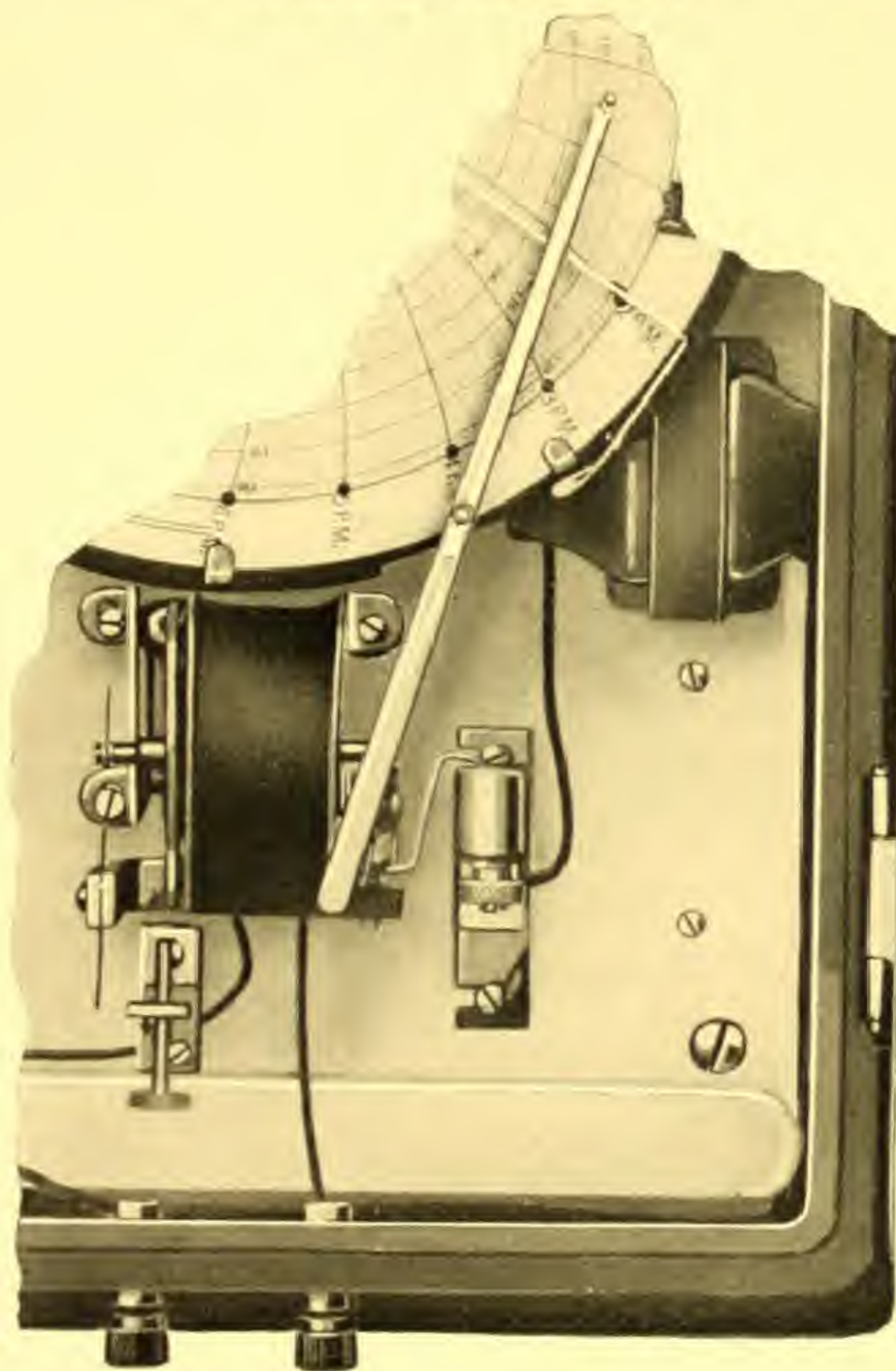
For 8-Inch Round Chart	2.20
For 12-Inch Round Chart	2.75

(When ordering Chart Holders, specify whether for wall or shelf use.)

ALL THE ABOVE PRICES ARE F. O. B., WATERBURY, CONN.



## ALARM ATTACHMENT FOR ELECTRICAL RECORDING INSTRUMENTS



Sometimes it is desirable to have a warning of minimum or maximum conditions, or both. For such places a contactor equipment as shown in illustration can be furnished to sound an alarm. This can be supplied with recording electrical instruments using Bristol's Movements. It not only includes Voltmeters, but also Ammeters and Wattmeters.

For example, if recording voltmeter is installed in connection with an important circuit, contactors can be set so that the alarm will sound should the circuit go dead.

A recording ammeter when used to determine load on individual motors can be equipped to sound alarm at critical point of overload.

An important use of the attachment in connection with wattmeters, is to sound alarm when total load reaches maximum peak, and thus used as a demand meter.

The necessary power for operating alarm attachment can be supplied from dry cells or lighting circuit.

The additional space required for installing the alarm attachment does not permit the use of Models 11 or 47, but makes it necessary to use the rectangular case. It is not practical to install the alarm attachment outside of the laboratory, but instruments already in the field may be returned to be equipped.



TRADE MARK  
**BRISTOL'S**  
REG. U. S. PAT. OFFICE.



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WATERBURY, CONN., U. S. A.

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*The Most Extensive Line of Recording Instruments in the World*

#### PRESSURE AND VACUUM

Bristol's Recording Pressure and Vacuum Gauges

#### LIQUID LEVEL

Bristol's Recording Water Level Gauges

Bristol-Derr Water Level Gauges for Steam Boilers

#### TEMPERATURE

Bristol's Class I Recording Thermometers

Bristol's Class II Recording Thermometers

Bristol's Class III Recording Thermometers

Wm. H. Bristol Indicating and Recording Electric Pyrometers

Bristol's Temperature Controllers

#### HUMIDITY

Recording Wet and Dry Bulb Thermometers

#### ELECTRICITY

Bristol's Recording Voltmeters

Bristol's Recording Ammeters

Bristol's Recording Wattmeters

Wm. H. Bristol Recording Milli-Voltmeters

Wm. H. Bristol Recording Shunt Ammeters

Bristol's Recording Frequency Meter

#### TIME

Bristol's Electric Time Recorders

#### MOTION

Bristol's Mechanical Time Recorders

#### SPEED

Bristol's Recording Tachometers

#### MISCELLANEOUS

Supplies for Bristol Recording Instruments

Bristol-Durand Radio Averaging Instruments

Gaugeboard Clocks

Bristol Engine Counters

Bristol Revolution Counters

Bristol Patent Safety Set Screws

*Bristol's Patent Steel Belt Lacing - The Perfect Fastener for All Kinds of Belts*



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# THE BRISTOL COMPANY

WATERBURY, CONN., U. S. A.

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Boston New York Philadelphia Birmingham Pittsburgh Detroit Chicago St. Louis San Francisco

BULLETIN

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NO. 281

## BRISTOL'S RECORDING ELECTRICAL INSTRUMENTS—STRIP CHART TYPE

Voltmeters      Ammeters      Wattmeters      Frequency Meters

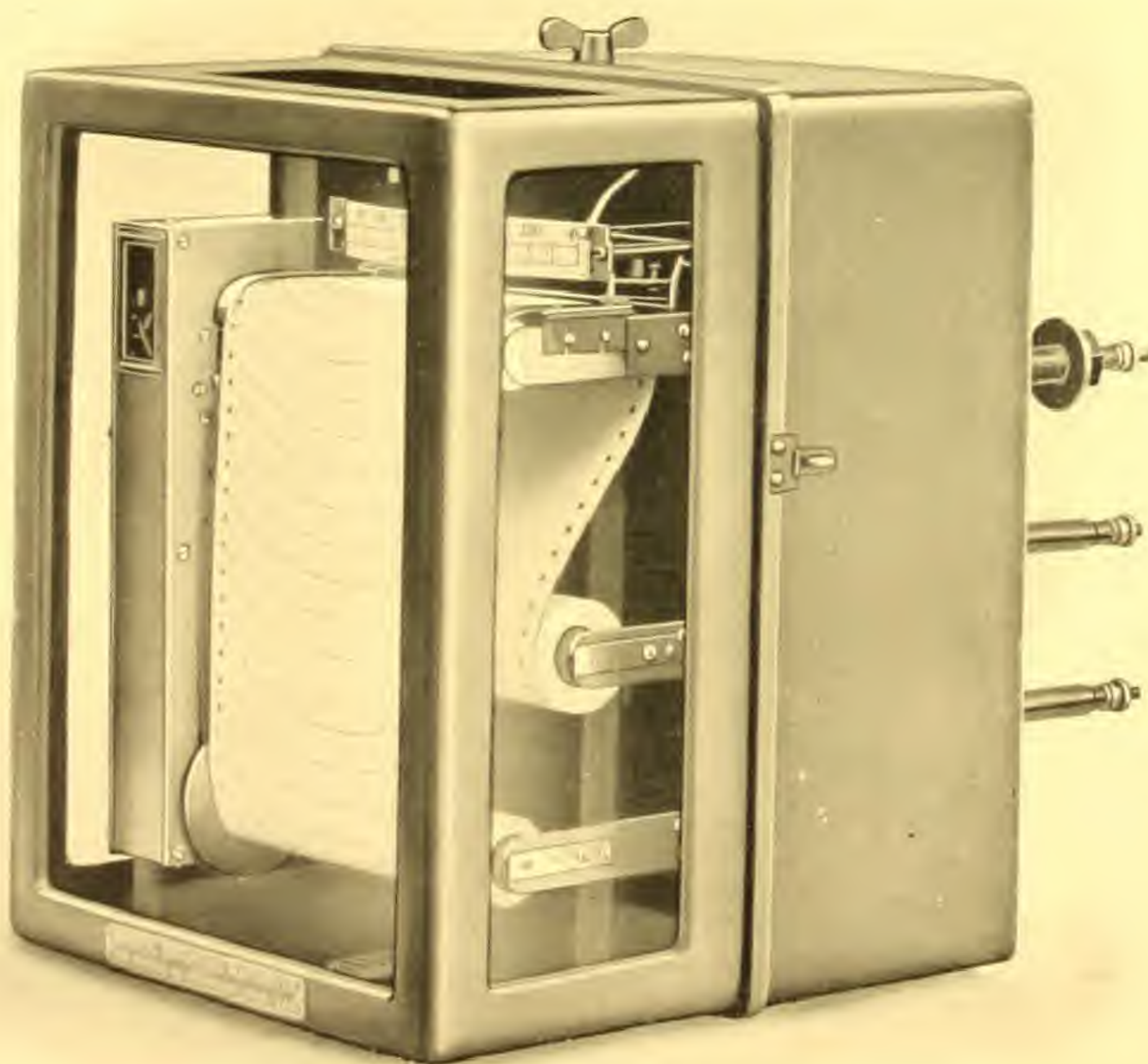


Fig. 1409

SWITCHBOARD MODEL 726



## FOREWORD.

The instruments described herein are the result of many years of research and engineering work to so refine the designs that the usual errors encountered under service conditions will be reduced to a negligible factor. All unnecessary parts have been entirely avoided.

Special attention has not only been given to the design of the electrical movements, but to the means of transmitting the record to the paper as well. The recording arms are so perfectly balanced that friction of the pointer on the chart is practically eliminated. The resulting accuracy of operation is greater than was thought possible in connection with recording instruments even a short time ago.

The extreme care in properly insulating these recorders and to arrange the connections in such a way that danger of short circuits is reduced to a minimum is of interest and of great importance to every user of electrical instruments.

The many innovations after extensive use under service conditions have in many industries demonstrated the success of the ideas. The complete instruments closely approach the ultimate in design.

Three different types of cases have been adopted as covering completely the usual commercial requirements. The first is the switchboard type of case, which, when mounted on a board, does not show the supports or electrical connections. The second design is the wall type case. This is furnished with three lugs for mounting at points where it is not possible to conveniently install a switchboard type of instrument. The wall type of recorder has the electrical connections at the side of the case, with conveniently arranged binding posts. The portable type of recorder is conveniently arranged for carrying about on test work and the complete instrument is so designed that it does not require extreme precision in leveling prior to use.

The electrical movements selected for each class of service are those which have been found through many years of development to be best adapted for those services. For instance, the dynamometer movement, which it is well known cannot be excelled for accuracy on alternating current, has been so refined in design as to require a very small amount of current for operation and, in addition, to have a torque which prevents inaccuracy due to unusual conditions of operation which cannot be avoided.

The direct current electrical movement operating on the D'Arsonval principle needs no introduction to users of electrical instruments. This movement is naturally furnished with double pivots and delicate suspensions have been entirely avoided. The torque is such that the recording arm is designed to rest continuously on the chart, and fluctuations of voltage or current are, therefore, clearly recorded regardless of the rapidity of the changes.

One of the men on the meter committee of the National Electric Light Association has stated that the Bristol Strip Chart Instrument is the best on the market, bar none. This bit of evidence is the opinion of a man well versed in requirements of good instrument construction, hence its value as an authoritative statement.

Further information is given in the following pages.

Prices are on pages 18 and 19.

Directions for Ordering are on page 19.



## Wall Type Instrument.



Fig. 1420.

Designed for convenient installation in cases where it is not possible to mount instruments on switch boards. Three lugs are supplied, making a convenient three-point support.

Suitable for containing electrical movements to record volts, amperes, watts or cycles and constructed of cast iron, providing requisite strength and protection electrically. As the service obtained from recording electrical instruments is largely dependent upon the rigidity of the case in which the electrical movement is mounted, so that it is not possible for any of the parts to be thrown out of alignment, particular attention has been paid to this feature of the design.

The standard finish is a durable black enamel of excellent appearance.

The case for switchboard mounting, as shown on page 1, is of slightly different construction, the lugs being eliminated and suitable terminals for supporting the instrument and for the electrical connections being extended through the back.

Dimensions of these cases are shown on page 15.

Prices for complete instruments are on pages 18 and 19.



## Portable Type Instrument.



Fig. 1411.

A case of as light weight and as small dimensions as it is possible to provide for an instrument of high-class electrical characteristics and with a clock which will perform accurately at all speeds.

The material is of aluminum and the base has adjustable leveling screws, although Bristol's Recorders are so designed that it is not necessary to adjust for level with extreme care prior to operation.

For dimensions refer to page 14.

Prices are listed on pages 18 and 19.

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## Portable Instrument—Rear View.



Fig. 1093.

A portable instrument which is not a complete unit in itself is not well constructed, therefore every Bristol's instrument involving an external resistance, as in the case of voltmeters and wattmeters, is furnished with a resistance box attached permanently to the back of the case, except those for unusually high voltages. This feature is of considerable importance as it eliminates the necessity of making a special record of the resistance box in the laboratory and checking this each time the instrument is used to make sure that the proper box will be connected to it.

Testing motors, analyzing load conditions for establishing rates and many other services of a similar nature may be demanded of this instrument. As the recording arm rests continuously on the chart the most violent fluctuations of load are clearly recorded.

Dimensions of this instrument are shown on page 14.



## Interior View, Showing Dynamometer Movement.

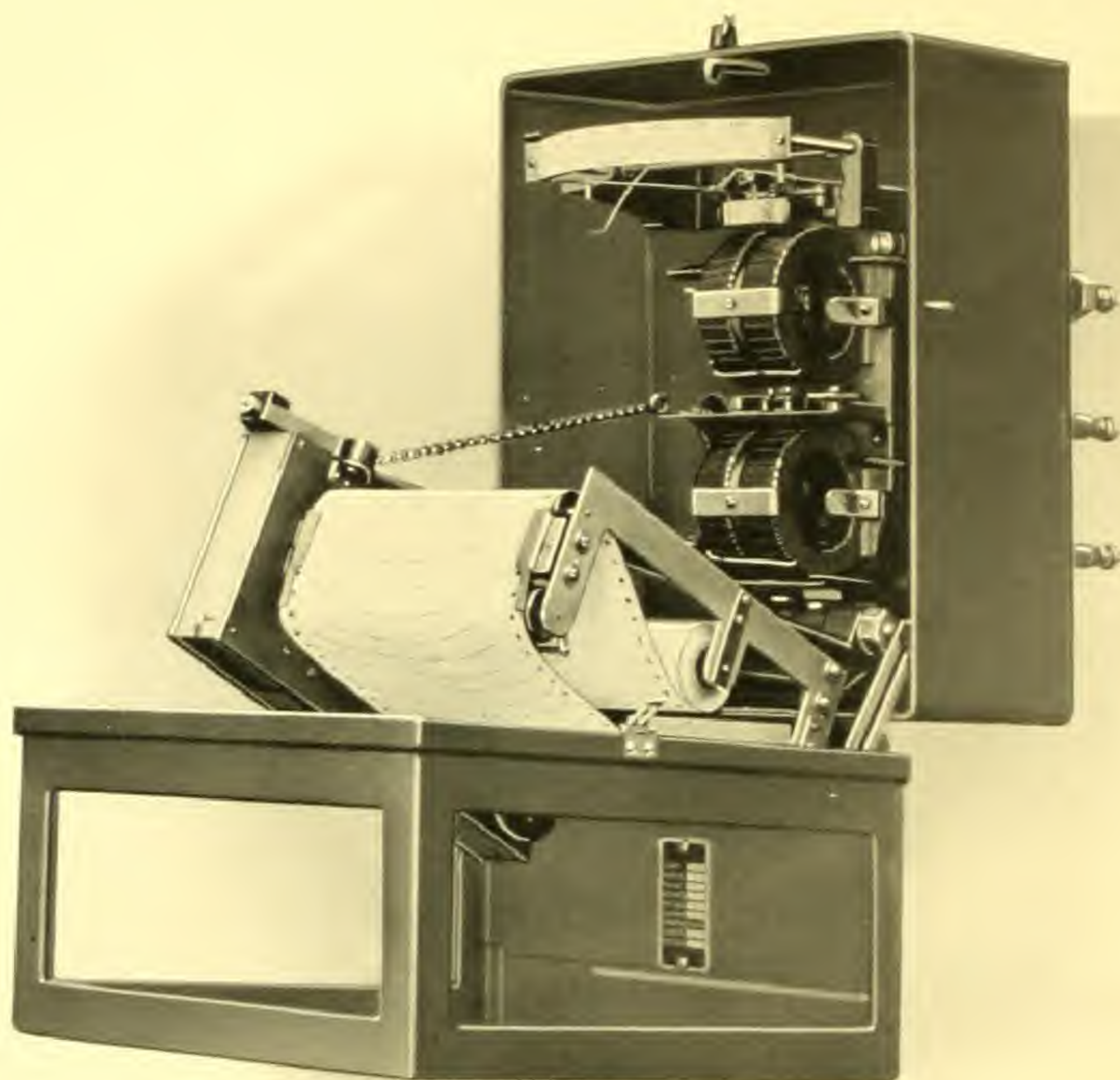


Fig. 1412.

Accessibility of the interior of a recording electrical instrument is of prime importance. Although Bristol's Recorders do not require frequent inspection or adjustment, this feature has been maintained constantly in mind. It will be found that when the door is opened and the clock frame supporting the chart lowered, the electrical movement and all other parts are very easily reached.

The above illustration expresses clearer than words the idea which we have endeavored to convey. In the design of each instrument it will be found that this same careful thought in regard to every detail has been shown. That is why so many of these recorders are maintained successfully in operation throughout long periods of time by customers in every section of this country, as well as abroad.



## General Characteristics.

There is no doubt that a properly designed and constructed recording instrument, when made to record directly on the paper without the use of motors or relays gives the greatest accuracy, because the relay type of instrument is of necessity complicated, involving the use of contacts, motors or solenoids. These parts must all function together and as there must be some distance between maximum and minimum contact, lost motion results in the various levers that transmit the motion to the inking device. The advantage of a well constructed electrical movement is lost.

In a recording instrument it is not a question of accuracy in the electrical movement alone, but of how accurate is the ink record on the chart under varying conditions, and how accurate will the instrument be after a year of service. With these and other considerations in mind, the instruments described herein mark directly on the chart without the use of relaying means.

The principles of operation involve the use of the D'Arsonval permanent magnet type of movement, the dynamometer type and the soft iron type.

Each type has been selected because of its peculiar fitness for the task to be performed. In connection with voltmeters and ammeters for operation on D. C., there is no better type of movement than the D'Arsonval permanent magnet. Not only does it adapt itself to a very high initial accuracy, but remains accurate under normal service conditions for a long period of time. The dynamometer type of movement shows particular adaptability to operate on A. C. and has been selected for use in Bristol's Recorders because when properly designed it incorporates more desirable features for use on A. C. than any other type of movement. It is also adaptable for use on D. C. at a slight sacrifice of accuracy. The soft iron type, as used in the frequency recorder, has a very sensitive and accurate movement for recording frequency, and the results which are possible with this Bristol soft iron type of movement are highly pleasing to the operator who requires excellent accuracy, and the strength of construction which means uninterrupted operation.

## Voltmeter—Alternating Current.

For this service a dynamometer type of movement is used, consisting of two stationary coils, as well as a movable coil which is fastened to a steel shaft, rounded and polished at its lower end. It is supported on a sapphire end-stone jewel, being guided by a ring stone. The upper bearing is also guided by a ring stone.

This construction insures a moving element having an infinitesimal amount of friction, and with the required degree of strength. A shipping device is arranged to lift the moving element off the lower jewel during transportation. Simply shifting a lever, accomplishes this result.

The three coils are connected in series, the current being lead into the moving coil by two oppositely wound bronze springs, which also serve as the control.

The self induction of this movement is so small that it can be used on any frequency from 25 to 133 and on any wave form with an accuracy within two per cent. of the scale range. When used on the frequency for which it is adjusted the accuracy is better than one per cent. over the entire scale. The power consumption on a 110-volt circuit is less than 15 watts. The chart graduations follow strictly the law of squares, as shown by the specimen section on page 13.



## Voltmeter—Direct Current.

The D'Arsonval permanent magnet type of movement is recommended for service on direct current. The theory of the design and operation of such an instrument is so well known that we will not dwell on that topic. From the illustration on page 9 an excellent idea of the simplicity of design will be secured. The movement is large, having a sufficient torque to accurately control the recording arm, which rests continuously on the chart, avoiding the use of a vibrating device, as is necessary with instruments of weaker construction, in which it is not possible to have the pointer rest continuously on the chart.

An accuracy within one and one-half per cent. of the scale range is assured with these instruments. The power consumption on a 110-volt circuit is about 1.5 watts. The chart graduations are uniform along the arc covered by the recording arm.

The dynamometer type of movement may also be used on direct current, although it is not especially recommended for this service, owing to the fact that it is especially designed for alternating current, and the D'Arsonval movement described above is of so much better design for direct current service. However, when the dynamometer type of instrument is used on direct current an accuracy within two per cent. of the scale range will be secured at any point on the chart.

Range limitations on these instruments are not marked, as calibration can be made for almost any magnitude, through the proper amount of resistance inserted in series with the instrument.

## Ammeter—Alternating Current.

This instrument is very similar in construction to the dynamometer type voltmeter, the chief difference being in the method of winding the coils, which necessarily employ very different sizes of wires.

This recorder, however, is somewhat of a new departure from ordinary practice. As a movable coil is used with control springs to lead the current into this coil, it follows that the springs cannot carry five amperes, for which standard instrument transformers are wound. The movement is, therefore, wound to carry one ampere and a small current transformer, ratio 1 to 5, is mounted inside of the instrument; thus making it a standard five ampere recorder. This method eliminates errors due to shunting the movable coil and makes possible a very powerful movement with a small power consumption.

An accuracy of better than one and one-half per cent. of the scale range is obtained, with a power consumption of less than 10 watts. The chart graduations follow strictly the law of squares.

Owing to the form of construction used with this instrument it is only offered wound for five amperes in connection with transformers, and this, in fact, takes care of practically all alternating current requirements. Of course it cannot be used on D. C., and, in fact, there is no need to use the dynamometer movement on D. C., when the D'Arsonval type instrument is available, as described on the next page.



## Direct Current D'Arsonval Movement.

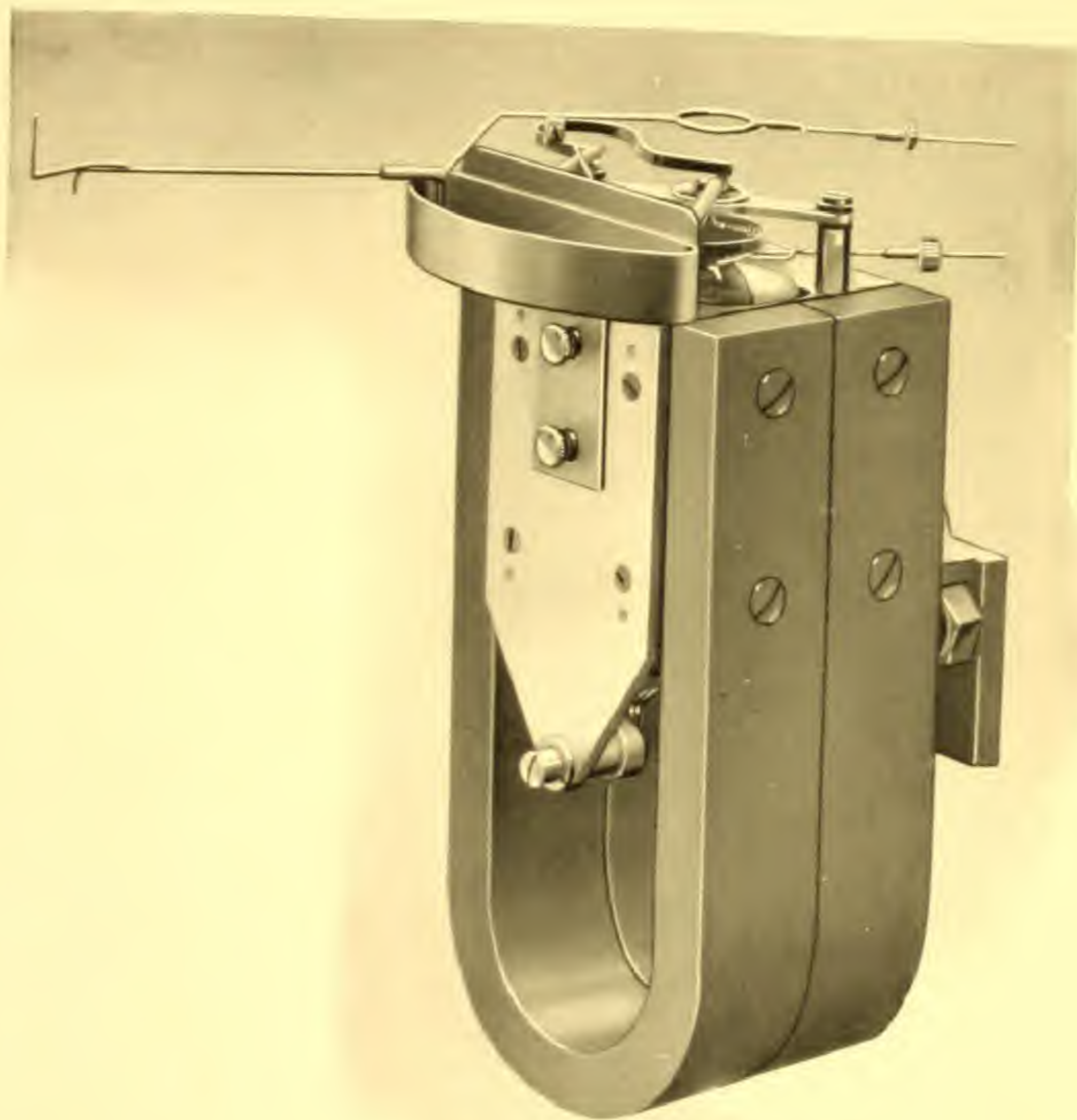


Fig. 1415.

## Ammeter—Direct Current.

This instrument also employs the D'Arsonval type of movement similar to that employed in the voltmeter. It is designed for use with shunts having a 100 millivolt drop. The power consumption of this movement is only about .005 watt. The chart graduations are uniform along the arc followed by the recording arm. An accuracy within one and one-half per cent. of the scale range will be secured under all conditions of service.

Leads can be furnished 100 feet or more in length, if required. Standard length of leads is 35 feet, and will be furnished, unless otherwise specified.



## Wattmeter—Alternating Current.

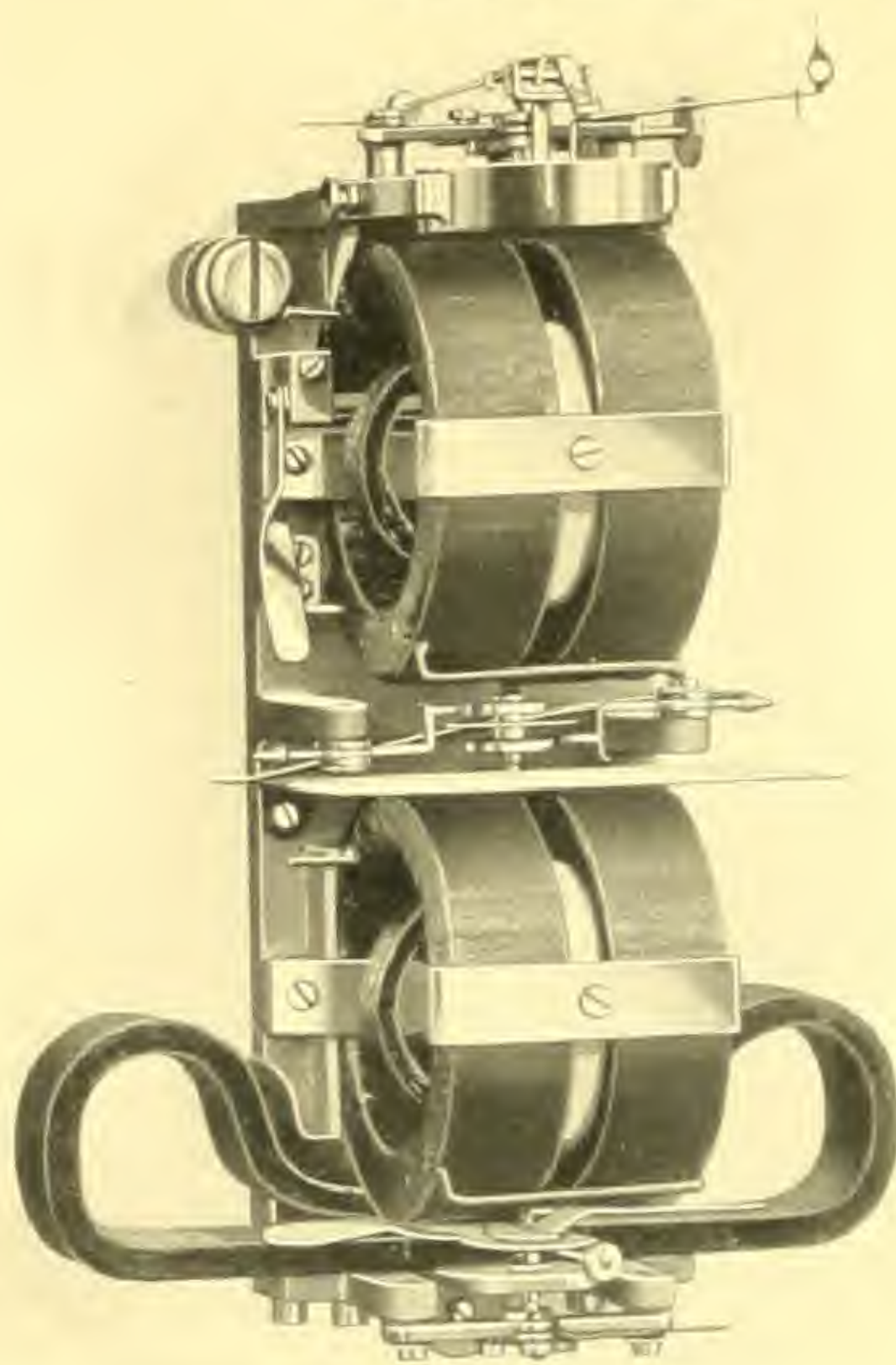


Fig. 1408.

to this high ratio, so that the instruments can be used on any commercial frequency, including 133 cycles, and still retain an accuracy within one per cent. of the scale range. They are of course equally immune from errors due to changes in power factor. These instruments are made for both single and polyphase service.

## Wattmeter—Direct Current.

The general form of construction for this type of instrument is in many respects similar to the A. C. Recorder. The maximum current capacity is 400 amperes. Higher current capacities are not arranged for, as they necessitate the use of external shunts, and the temperature error is necessarily too great for average commercial services, it not being possible to so wind the coils that this error is eliminated.

For the maximum current capacity mentioned, however, the Bristol's Recording Wattmeter for D. C. will be found as accurate as the alternating current recorder under average service conditions.

This direct current instrument can also be furnished in connection with three-wire systems for voltages up to 750. Current coil rating in amperes are as follows:

5	100
10	150
20	200
50	300
75	400

In the design of dynamometer movement utilized by these recorders the coils have been carefully formed in order that a magnetic field will result which will be uniform throughout the arc covered by the recording arm. Although the power lost in the instrument coils is extremely small the torque is exceptionally high and the response to changes in the circuits is very rapid.

The current coils are wound for five amperes and the potential coils are rated at 100 volts for use in connection with standard instrument transformers. However, where desirable the potential coils can be wound for higher voltages, eliminating the use of transformers.

The power consumption in the coils on 110-volt service is less than 10 volt-amperes per potential element and less than 3 volt-amperes per current element. The ratio of copper to zero temperature coefficient wire is about 1 to 10, reducing the temperature error to an infinitesimal quantity. The reactance of the potential circuit becomes very low, due

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## Frequency Recorder.

This type of instrument operates on the soft iron plunger principle, having stationary coils and movable coils. The coils are balanced and supported on exceptionally strong knife-edges. Controlling springs are not used, as the electrical forces in the coils determine the position taken by the moving system. A novel form of phase-splitter is made use of with this instrument, involving the use of a condenser and resistor in one branch and a reactance in the other branch. The coils and iron cores being relatively large, have considerable reactance, so that should the instrument be used with the common type of resistance reactance phase-splitter, a very small motion would be had for a comparatively large frequency variation. By including the condenser in the resistance branch and balancing the circuit to resonance for the critical frequency that the instrument is to record, a very open scale is obtained. It is possible to cover the full scale by a change of three cycles.

## Zero Adjuster.

This device is supplied on every Bristol's Electrical Recorder and is operated simply by turning a small screw. This may be seen on the wattmeter movement shown in Fig. 1408 on page 10, at the upper right corner. It is not necessary to frequently use this device, as the controlling springs are remarkably consistent in service, but it will obviate the necessity of a recalibration when simply small changes are necessary, due to a slight change of spring tension.

## Balanced Pointer.

Chart friction has, in the past, caused a varying degree of accuracy with many recording instruments, owing to the fact that the smoothest chart paper has some unevenness of surface. The only way to overcome this is to adjust the pointer so that the ink is transferred to the surface of the chart practically by capillary attraction. To accomplish this purpose the recording arm has a threaded end on which a balancing screw is mounted. This can be so adjusted that the pointer will barely touch the chart, and friction is avoided. This results in consistent records and a greatly increased accuracy.

## Inking System.

An extension on each recording arm for all of these recorders is made to project downward about midway between the tip and the point of support on the moving coil into an ink reservoir. This projection and the recording arm are really in the form of a hollow tube, so that the ink syphons to the tip, which rests on the chart. See Fig. 1415 on page 9. As soon as the ink is started, it will continue to flow and, due to the capillary attraction, will readily feed on the chart, even though the fluctuations in the record are very rapid. This result is secured with the pointer resting so lightly on the chart that friction is practically eliminated.

Full directions are always furnished for starting the ink through the recording arm and this method will be found so efficient that in continuous service the inking system will seldom, if ever, require special attention. Dotting type mechanisms are not employed with these instruments. The recording arms in each instance rest continuously on the chart.

MOTION, ETC.

MOTION, ETC.



## Damping.

Alternating current instruments are equipped with magnetic dampers, as illustrated in Fig. 1408 on page 10. Direct-current instruments, owing to the disturbance which the magnetic damper would cause in the magnetic field, are equipped with oil dampers, as illustrated by Fig. 1413. Note especially that the oil damper is entirely enclosed and is therefore of the non-spilling type. Enclosed in the dash pots are several vanes. The viscosity of the oil contained therein governs the degree of damping.

D'Arsonval movements, which are illustrated by Fig. 1415 on page 9, are damped by the aluminum frame upon which the coil is wound. This is a closed rectangular frame moving in the field of the permanent magnet.

A current is generated in this frame which opposes the movement of the pointer, as the current is generated in proportion to the speed at which the magnetic lines are cut. This insures very effective damping.

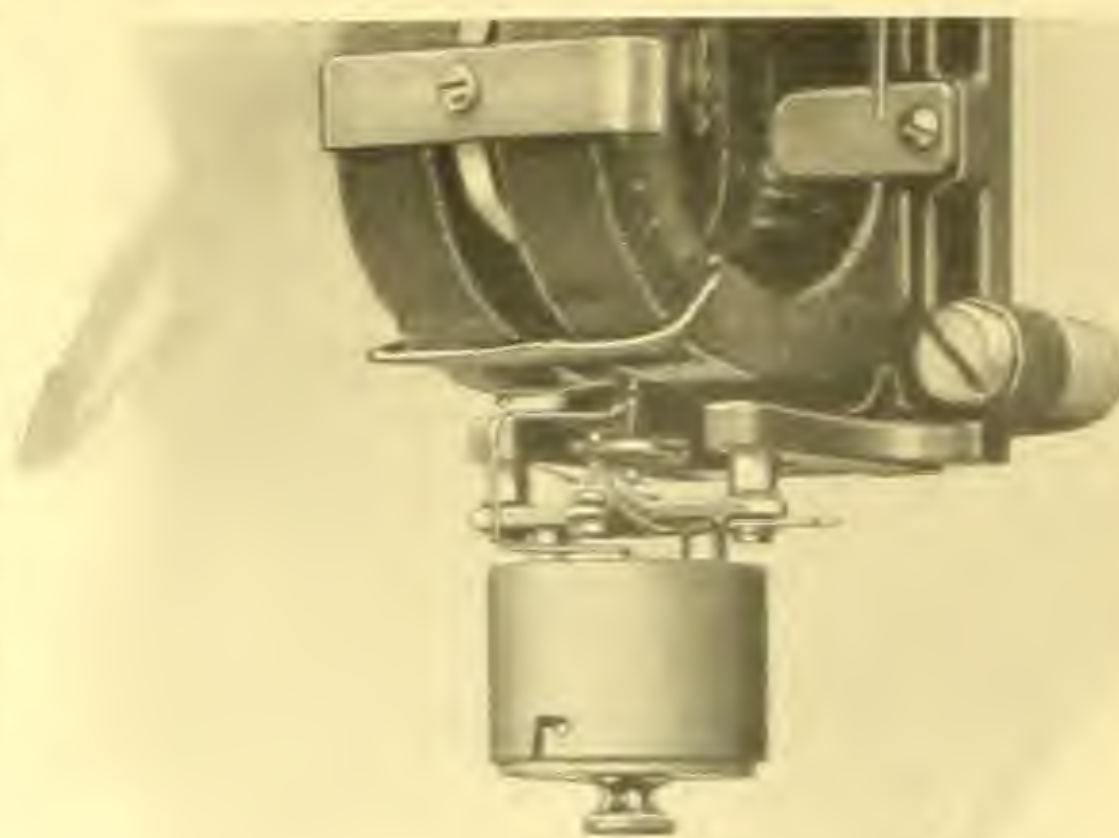


Fig. 1413.

## Pens.

All pens are removable and in case of accident may be easily replaced by users of these recorders at very small expense. The amount of time required for the change is only a few seconds.

## Clocks.

The Bristol Clocks are especially constructed by our own experts for the Strip Chart Recording Instruments. These are as small as possible with due consideration given to time-keeping qualities and the necessary strength for driving the chart.



Fig. 1414.

Various speeds may be secured by shifting a lever or substituting gears. Fig. 1414 illustrates a standard gear plate, which is held in place by two screws. Simply shifting a lever will change the chart speed from one inch per hour to one inch per minute. Other gears for three-inch and six-inch speeds are available. Winding is required every seven days.

Unless otherwise specified the instruments are furnished with a rerolling device, so that the chart can be rerolled as fast as the record is run off. When specified, however, instruments will be furnished with slots in the bottom of the cases through which the chart may feed. This eliminates the use of the reroll and sometimes is advantageous where a greater amount of the record should be visible than is otherwise possible.



## Charts.

The full width of the chart is 6 inches. The effective scale representing the units for which calibration is made is  $5\frac{1}{4}$  inches wide. Length of each chart is 90 feet, which is sufficient for fifteen days' continuous operation at a speed of 3 inches per hour.

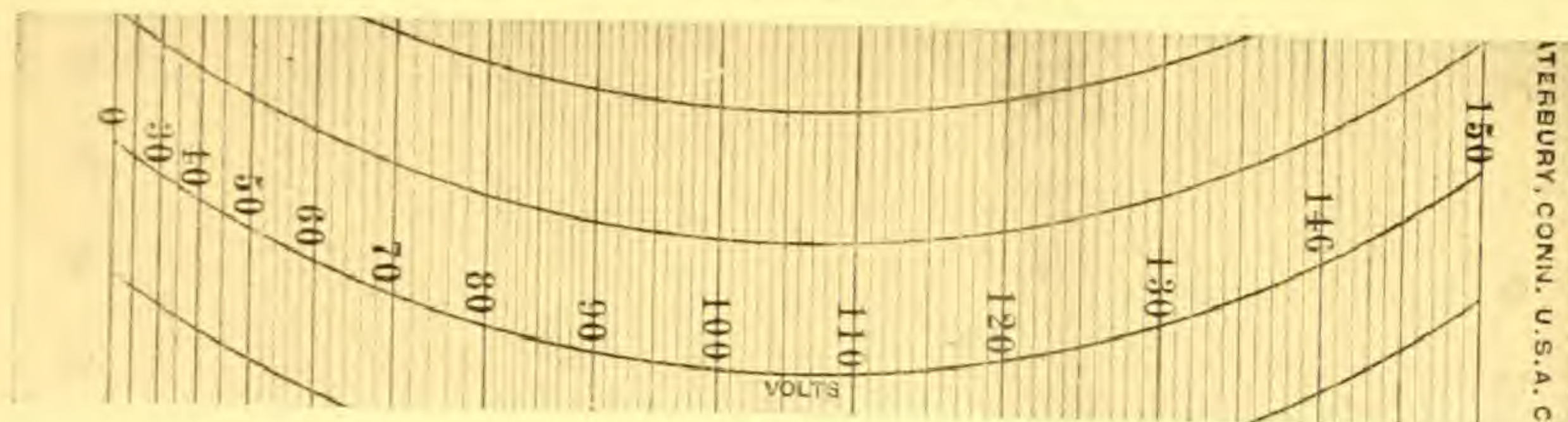


Fig. 1399.

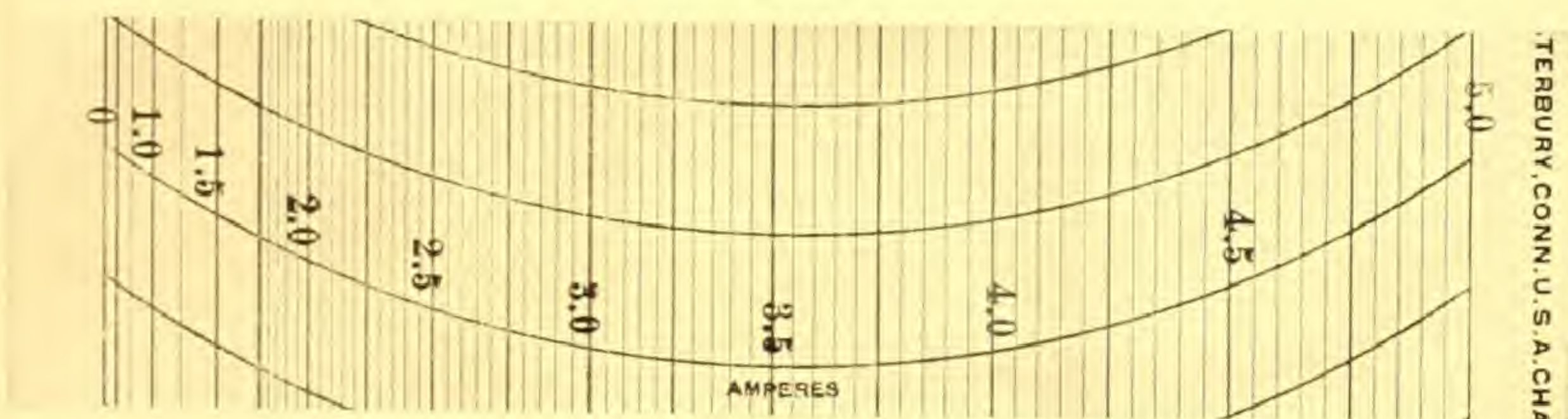


Fig. 1400.

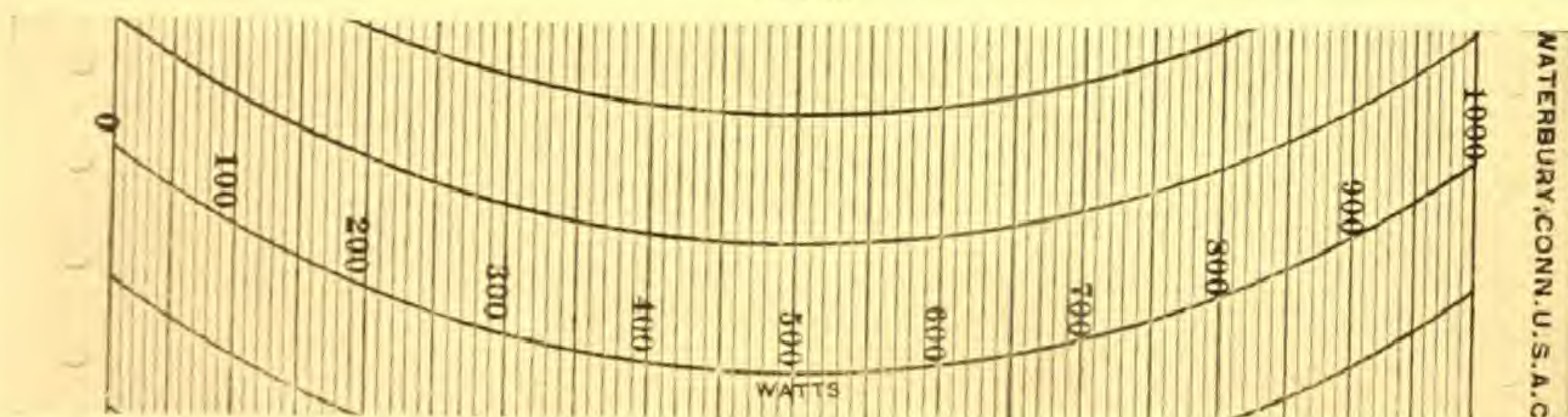


Fig. 1401.

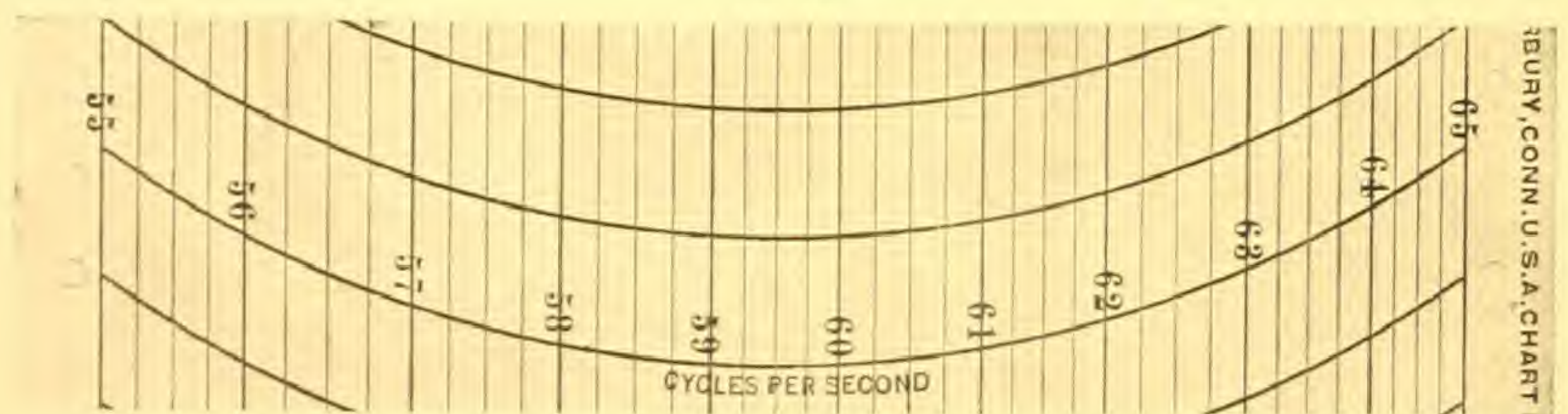


Fig. 1189.

The above illustrations show the characteristics of the chart scales for the different classes of instruments to record volts, amperes, watts and cycles. Other ranges are available to meet all standard requirements.

MOTION, ETC.



## Dimensions of Models 526, 626, 726, 1226.

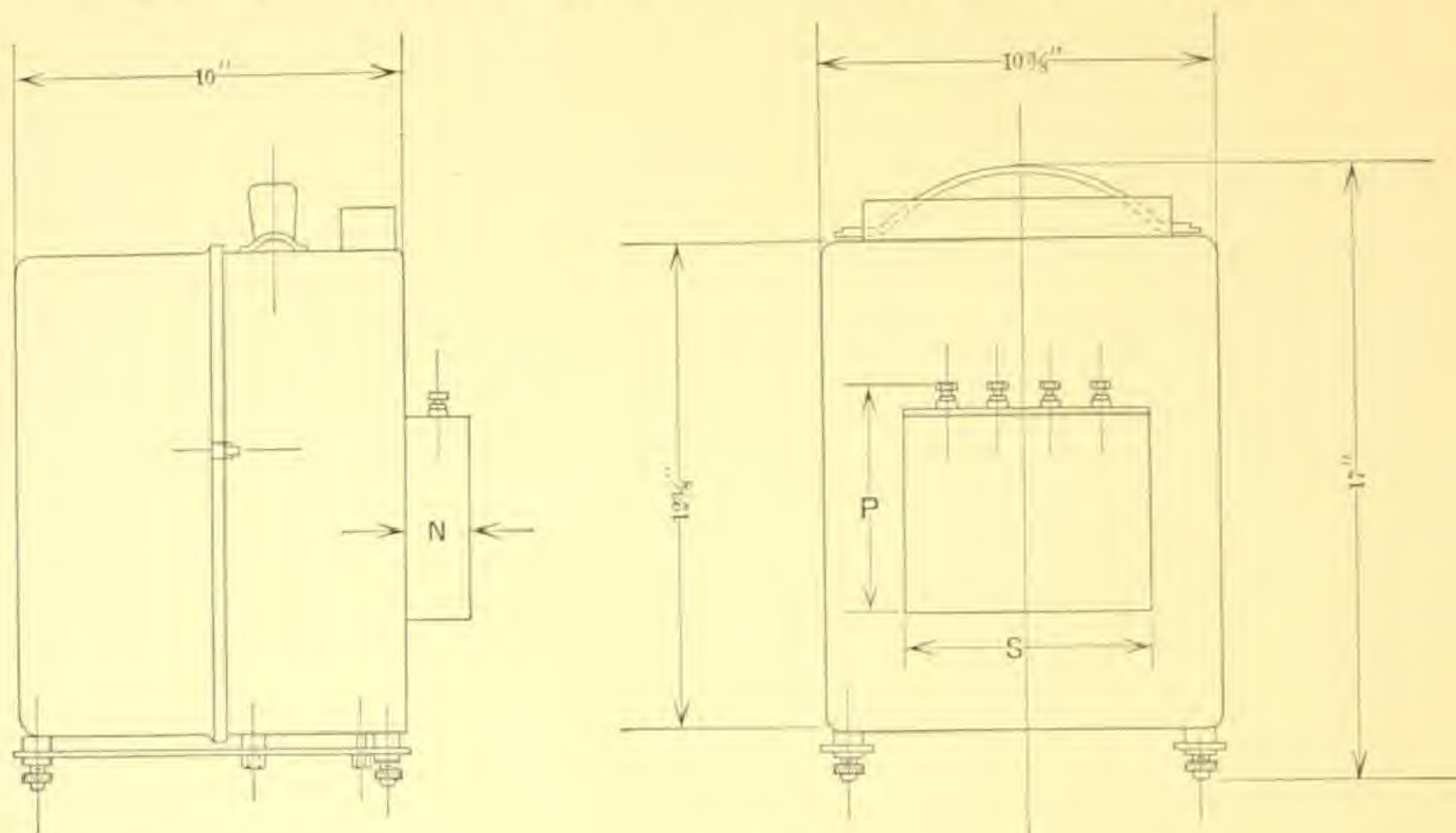


Fig. 1442.

Small resistance box attached to instrument, as above, has following dimensions:

N—1.6"      P—5.2"      S—6.2"

Large resistance box has dimensions as follows:

N—3.5"      P—11.3"      S—9.6"

Model 526 Voltmeter, 350 volts or less, requires small resistance box.

Model 526 Voltmeter, over 350 volts, requires large resistance box.

Model 626 Ammeter not furnished with resistance box.

Model 726 Wattmeter, 220 volts or less, requires small resistance box.

Model 726 Wattmeter, over 220 volts, requires large resistance box.

Model 1226 frequency recorder takes separate box of type shown below, large size, dimension L being 13.7". The box is then equipped with a handle.

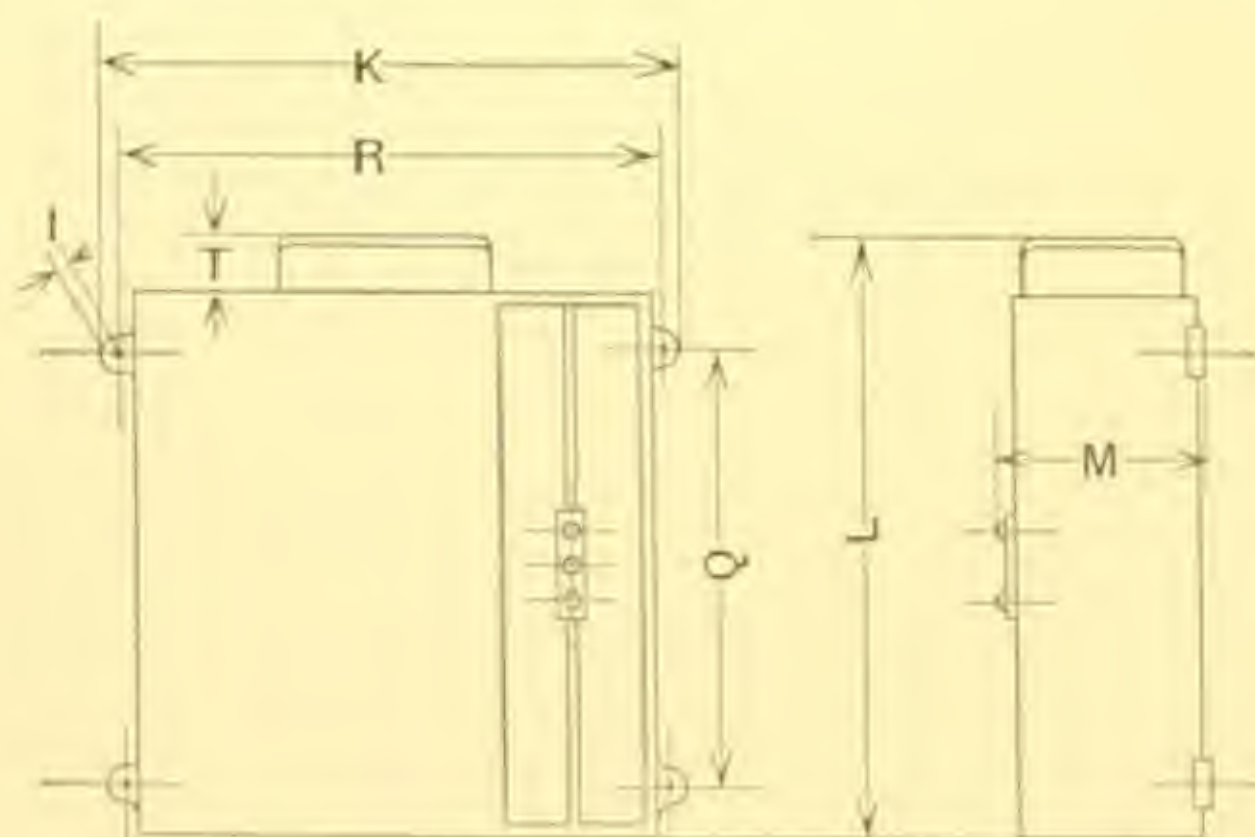


Fig. 1443

Dimensions of Small Box Figure:

K—7.2"  
L—8.3"  
M—3.5"  
I—0.2"  
Q—5.5"  
R—6.75"  
T—0.9"

Dimensions of Large Box Figure:

K—10.6"  
L—11.3"  
M—3.5"  
I—0.2"  
Q—8.0"  
R—10.06"  
T—1.1"



## Dimensions of Model 725 Wattmeter, Switchboard Type.

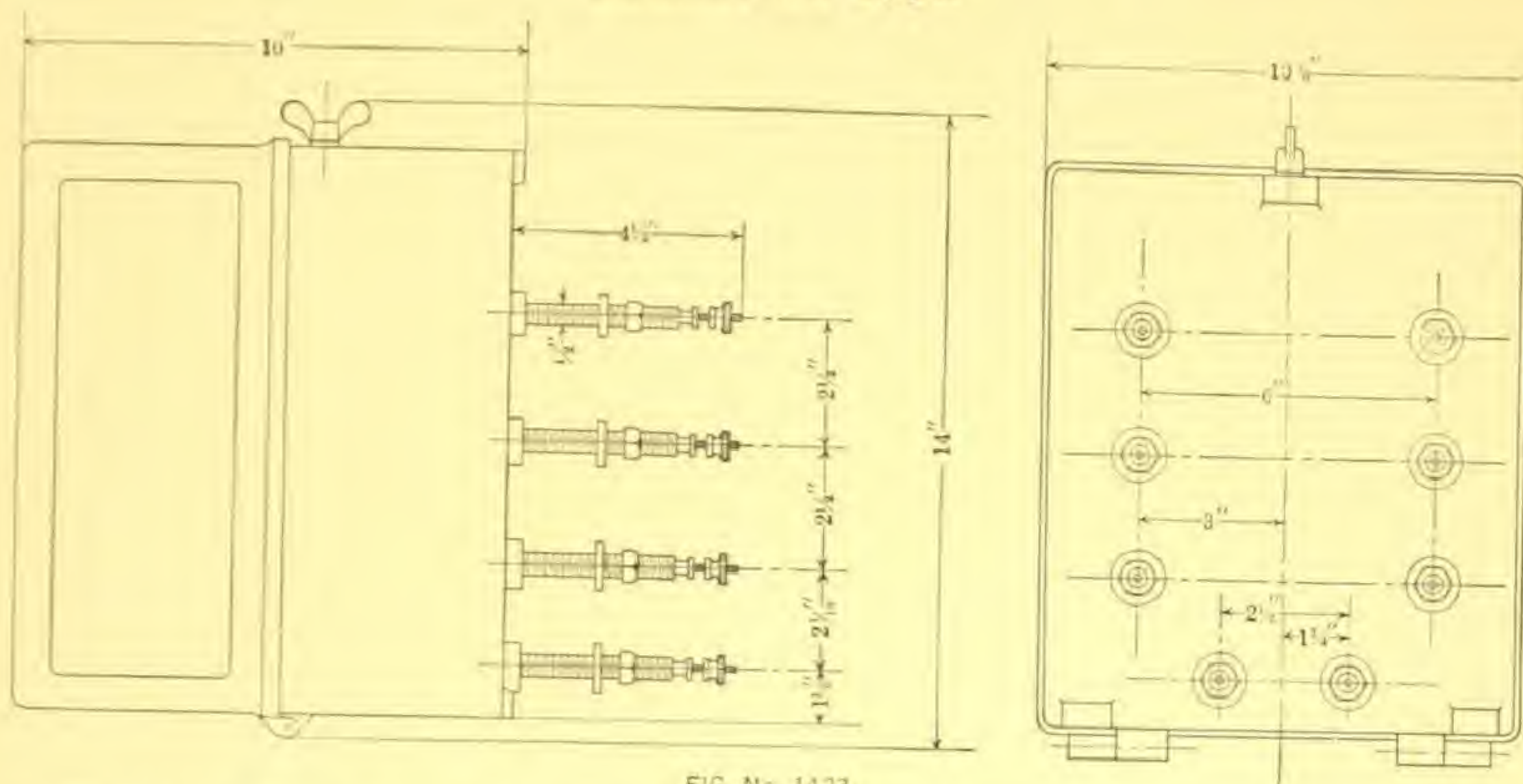


FIG. No. 1423

The above figure shows the dimensions of the switchboard type wattmeter with eight posts, as supplied for polyphase service.

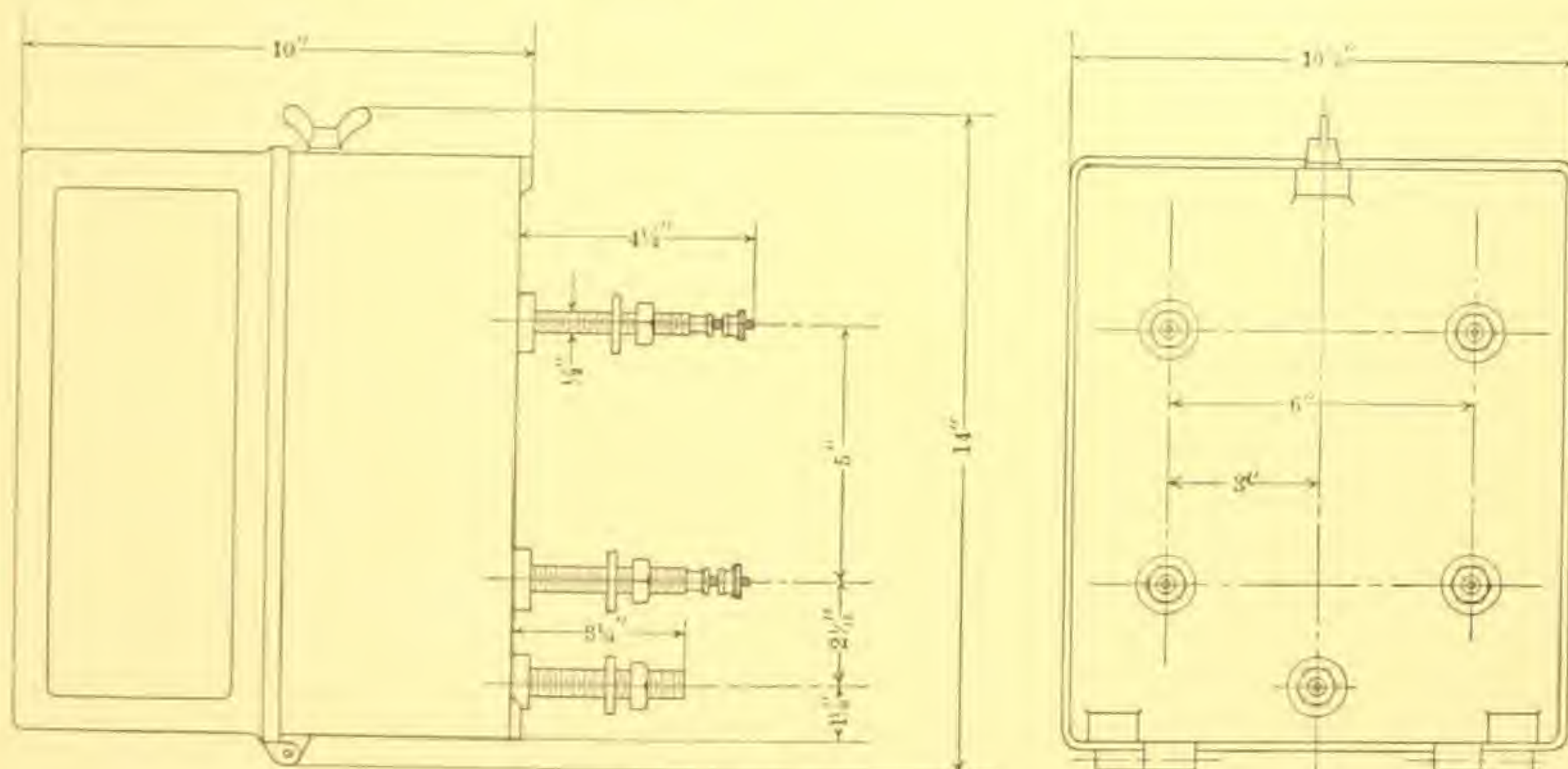


FIG. No. 1422

The above figure shows the switchboard type wattmeter with posts arranged as for single phase service.

Polyphase or single phase wattmeters of the wall type, as shown on page 3, have cases of the same dimensions, although the electrical connections are made at the sides and three lugs are supplied, one at the top and two at the bottom for mounting.

The above wattmeters take the large resistance boxes, dimensions of which are given on page 14.



## Dimensions of Voltmeters and Ammeters, Switchboard Type, Models 525 and 625.

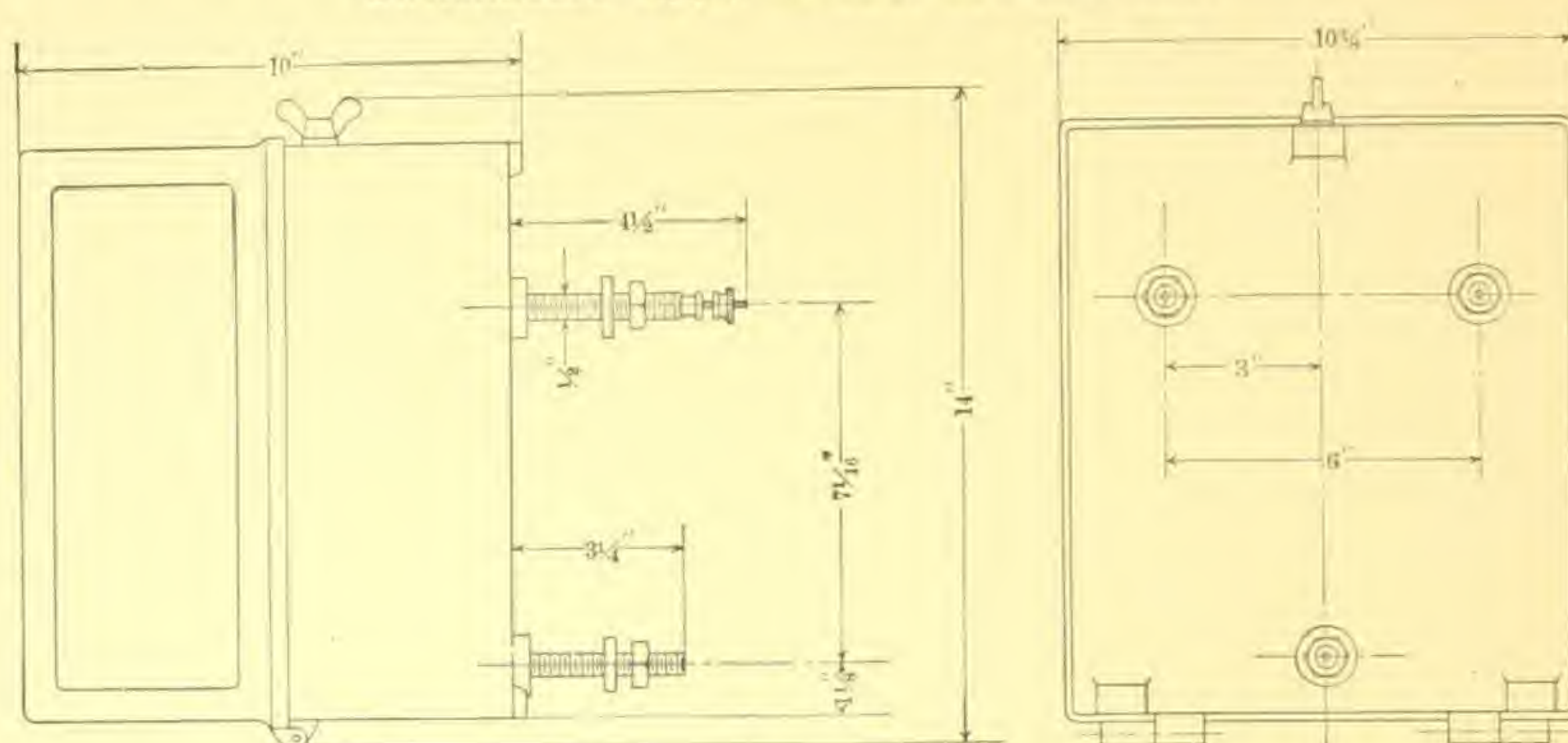


FIG. No. 1421

The above illustration shows the arrangement of connections for recording volts and amperes. The terminals also act as supports extending directly through the switchboard and being securely fastened by means of washers and nuts supplied for the purpose.

Resistance boxes for voltmeters, as above, are of the small size, dimensions of which are given on page 14, for voltages up to and including 300. Over 300 volts, the large boxes are required.

## Dimensions of Frequency Recorder, Model 1225, Switchboard Type.

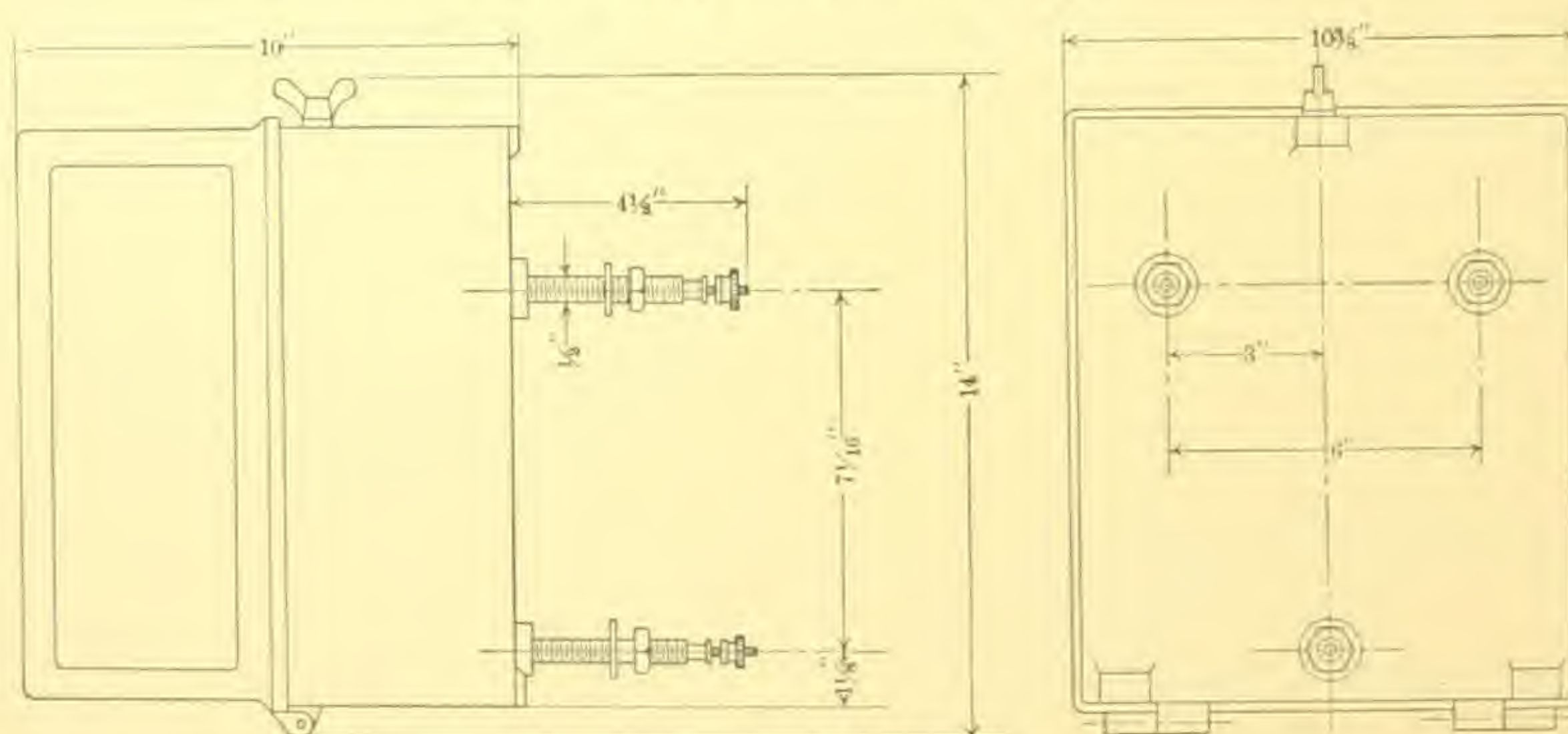


FIG. No. 1424

The wall type case in dimensions is similar to above, except for the elimination of the rear projection terminals or supports and the substitution of lugs, as illustrated on page 3.

Resistance boxes for the frequency recorder, as above, are of the large size, dimensions of which are given on page 14.



## Shunts.

100 millivolt drop is the standard for which all shunts used with Bristol's Recording Ammeters are adjusted. This provides sufficient power for the use of instruments which will record accurately every fluctuation of current, regardless of the violence of those changes. The recording arm of the ammeter rests continuously on the chart, eliminating the use of a vibrating mechanism. This avoids complication and is of great importance to every one requiring an instrument of this type.

## Transformers.

Alternating current instruments are furnished uniformly with current coils having a maximum capacity of five amperes and voltage coils with rating of 100 volts. They are, therefore, suitable for use with standard instrument transformers of the universal types regularly manufactured at this time. Although we do not manufacture transformers, we are in a position to furnish most standard types as requested.

## Selection of Wattmeter Range.

After selecting the model and type of wattmeter required, the important question arises as how to figure the range of the instrument and the chart which will be used. In connection with transformers, or without those transformers, the following formulæ will be of great help in this connection, explaining in simple terms the method necessary in arriving at the range of the chart which must be used for any combination of transformers or for any rating in amperes, and volts representing the self-contained capacity of the instrument without the transformers.

$$\text{FORMULA 1: } \frac{\text{Rated Amperage} \times \text{Rated Volts}}{1000} = \text{K. W. for single-phase}$$

$$\text{FORMULA 2: } \frac{2 \times \text{Rated Amperage} \times \text{Rated Volts}}{1000} = \text{K. W. for polyphase}$$

To determine the chart desired, instrument capacities as follows should be used in formula 3 for either single or polyphase instruments—current coils all wound for 5 amperes; potential coils for 100, 150, 200, 250, 300, 400 or 500 volts.

$$\text{FORMULA 3: } \frac{\text{Capacity of Instrument only} \times \text{Current Transformer Ratio}}{\text{Wattmeter with Transformers} \times \text{Potential Transformer Ratio required}} = \text{K. W. range of chart}$$

A chart having a total range of one K. W. is recommended with portable instruments, as it can be conveniently read with suitable multiplier in connection with transformers of any desired ratio.

NOTE:—For any instrument select voltage rating which is nearest your operating voltage; as an example, select 100 volts rating for 110 volt circuit or 200 volts rating for 220 volt circuit.

NUMERICAL

MOTION, ETC.



## Prices.

Voltmeter Model 525, switchboard type, dynamometer movement for A. C.	\$175.00 List.
Voltmeter Model 525, switchboard type, D'Arsonval movement for D. C.	225.00 List.
Voltmeter Model 525, wall type, dynamometer movement for A. C.	175.00 List.
Voltmeter Model 525, wall type, D'Arsonval movement for D. C.	225.00 List.
Voltmeter Model 526, portable type, dynamometer movement for A. C.	175.00 List.
Voltmeter Model 526, portable type, D'Arsonval movement for D. C.	225.00 List.

Above prices apply to instruments with range of 300 volts or less.

Transformers for A. C. quoted on request.

D. C. voltmeters for ranges in excess of 300 volts and not exceeding 900 volts, \$5.50 extra list. Higher ranges quoted on request.

Partial voltage scales are \$5.50 extra list for those which are standard. An illustration of this is a range of 90 to 140 volts.

Ammeter Model 625, switchboard type, dynamometer movement for A. C.	\$175.00 List.
Ammeter Model 625, switchboard type, D'Arsonval movement for D. C.	225.00 List.
Ammeter Model 625, wall type, dynamometer movement for A. C.	175.00 List.
Ammeter Model 625, wall type, D'Arsonval movement for D. C.	225.00 List.
Ammeter Model 626, portable type, dynamometer movement for A. C.	175.00 List.
Ammeter Model 626, portable type, D'Arsonval movement for D. C.	225.00 List.

All A. C. Ammeters are wound for five amperes for use with transformers. Prices on transformers quoted on request.

Shunts of 100 millivolt drop at full rated load are required for the D. C. ammeters. Shunt prices quoted on request.

Wattmeter Model 725, switchboard type, dynamometer movement for A. C.	
Potential coils wound for 300 volts or less, current coils for five amperes	\$210.00 List.
Wattmeter Model 725, wall type, dynamometer movement for A. C. Coils as above.	210.00 List.
Wattmeter Model 726, portable type, dynamometer movement for A. C. Coils as above.	210.00 List.

D. C. instruments are supplied at above prices for voltages not exceeding 750 and amperes of 400. Instruments are self-contained, avoiding the use of shunts. A. C. instruments for voltages exceeding 300, but not exceeding 750, \$22.00 extra list.



## Prices (Continued).

Wattmeters having taps for several different voltage ranges can be furnished if desired. Prices quoted on request.

Frequency Recorder, Model 1225, switchboard type, for circuits employing standard commercial frequencies, 110 volts.....\$225.00 List.

Frequency Recorder, Model 1225, wall type, for circuits as above, 110 volts, ... 225.00 List.

Frequency Recorder, Model 1226, portable type, for circuits as above, 110 volts... 225.00 List.

One transformer per frequency recorder is required for voltages exceeding 110.

Prices on transformers on request.

Extra chart rolls 90 feet long, each.....\$1.10 List.

Extra one ounce bottle special ink......30 List.

Extra clock gears, as per Fig. 1414, page 12, each..... 2.20 List.

## Directions for Ordering.

1. MODEL NUMBER required.
2. TYPE.—Switchboard type, wall type, or portable type.
3. RANGE in volts, amperes or K. W. Specify operating voltage in each instance, and in connection with amperes or K. W. state the maximum as well as average demand.
4. CHART SPEED, *i. e.*, 1-inch, 3-inch, or 6-inch.
5. For wattmeters, if alternating current, mention whether single, two or three-phase and number of wires. If for D. C., state whether two or three-wire circuit.
6. Transformers on A. C. are usually required, except for voltmeters and wattmeters used only on low voltages; therefore state if you wish us to furnish these. If already on hand, state ratios.
7. For A. C. wattmeters refer to formulæ on page 17. D. C. ranges are derived by use of formula 1.



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 Bristol's Recording Pressure and Vacuum Gauges

LIQUID LEVEL  
 Bristol's Recording Water Level Gauges

Bristol's Class I. Recording Thermometers	Bristol's Class II. Recording Thermometers
Bristol's Class III. Recording Thermometers	Bristol's Temperature Controllers
Wm. H. Bristol Indicating and Recording Electric Pyrometers	

HUMIDITY  
 Recording Wet and Dry Bulb Thermometers

Bristol's Recording Voltmeters	Bristol's Recording Ammeters	Bristol's Recording Wattmeters
Wm. H. Bristol Recording Milli Voltmeters	Wm. H. Bristol Recording Shunt Ammeters	
Bristol's Recording Frequency Meter		

TIME  
 Bristol's Electric Time Recorders

MOTION  
 Bristol's Mechanical Time Recorders

SPEED  
 Bristol's Recording Tachometers

Supplies for Bristol Recording Instruments	MISCELLANEOUS	Bristol-Durand Radil Averaging Instruments
Gaugeboard Clocks	Bristol Engine Counters	Bristol Revolution Counters
		Bristol Patent Safety Set Screws

Bristol's Patent Steel Belt Lacing—The Perfect Fastener for All Kinds of Belts



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MOTION, ETC.



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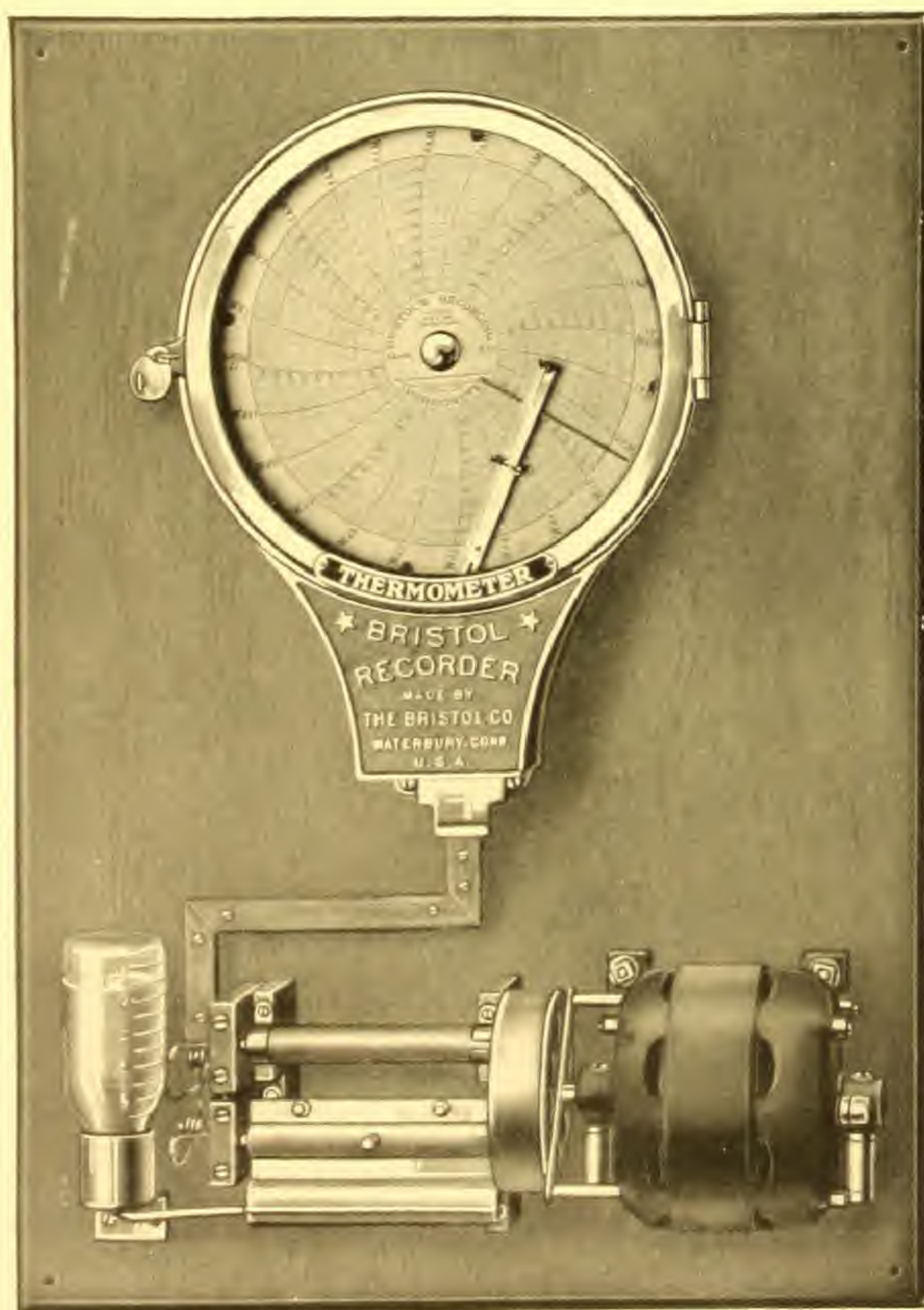
BULLETIN

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No. 318

## BRISTOL'S CLASS I RECORDING WET AND DRY-BULB THERMOMETERS

(Recording Psychrometer or Humidity Recorder)



MOTION, ETC.



# BRISTOL'S RECORDING WET AND DRY-BULB THERMOMETERS

## CLASS I SELF-CONTAINED TYPE

(Recording Psychrometer or Humidity Recorder)

The Class I Recording Wet and Dry-Bulb Thermometer is furnished only in the self-contained type, and is used when the instrument itself can be mounted at the exact location where it is desired to determine the relative humidity. This instrument can be furnished calibrated for all ranges between 32 degrees and 150 degrees F.

Although the recording instrument shown on page 1 is Original Form Model 110, with full nickel finish, the case most often used is the same in general appearance, but has plain front and is finished in black enamel. This is known as Model 111 and is the one for which list prices are given in this bulletin. Model 111 is made in two sizes using charts 12-inches and 8-inches in diameter.

For nearly all applications the Model 111 provides adequate protection for the working parts, but for some locations a more rugged and moisture-proof case is required. When this is necessary what is known as Moisture-Proof Model 140 should be specified. This particular model is not illustrated here, but is rectangular in shape, made of cast iron and finished in black enamel, using the same working parts and the same charts as for the Model 111.

The Bristol's Recording Wet and Dry-Bulb Thermometer consists of two complete recording systems: including two sensitive bulbs and two penarms mounted together in one case, and arranged to record on the one chart. One system records the temperature of the dry-bulb, or atmosphere; the other the temperature of the bulb kept moist and known as the wet-bulb.

The operation of Bristol's Recording Wet and Dry-Bulb Thermometer is based on the principle that evaporation varies with the amount of moisture in the atmosphere. The temperature of the wet-bulb is always lower than the surrounding atmosphere. The difference in the temperature readings of the wet-bulb and dry-bulb is known as the wet-bulb depression. This varies directly with the rate of evaporation, which rate is inversely proportional to the amount of water vapor in the air, at the indicated atmospheric temperature. By taking the dry-bulb temperature and noting the wet-bulb depression, the relative humidity in per cent can be readily ascertained by using the table furnished with the instrument.

The Class I Recording Wet and Dry-Bulb Thermometer equipment is mounted complete on a wooden panel ready for fastening to the wall or other support. The equipment includes the recording instrument, two sensitive bulbs, the water bottle, together with motor and fan.

The bulbs are mounted on a water reservoir in such a manner that the sensitive portion of the bulb does not come in contact with the metal of the reservoir. For this reason the temperature of the metal reservoir does not affect in any way the reading of the instrument. The wet-bulb is covered with a cloth wick and is kept constantly moist by water from the reservoir. The wick is easily removed for cleaning or renewal purposes. The reservoir is supplied from water in the inverted glass bottle, as shown in the illustration. A supply of clean water should always be kept in the bottle, and thus a constant level of water is maintained in the reservoir.

In place of the water bottle a special attachment can be furnished whereby a continuous water supply may be secured from the city water system. The price for this special attachment furnished on request.

To insure good results with Bristol's Wet and Dry-Bulb Thermometers it is necessary to have a flow of air over the wet-bulb, of at least 12 feet per second. To supply this flow of air a motor and fan is furnished. The motor is a standard make and can be supplied for all commercial voltages for both A. C. and D. C. Sometimes, instead of using the motor and fan, the cover over the wet-bulb is removed and a circulation of air is secured by a suction fan installed outside the room.

The Recording Wet and Dry-Bulb Thermometers described above are used most extensively to check the accuracy of humidifying apparatus in such places as: Working Rooms in factories, School Rooms, and Public Buildings, in connection with certain processes in the industries as, Dry Kilns, Drying and Weaving Rooms in textile and silk mills, rooms where Kodak Films are made, Powder Storage Rooms in powder factories, Tobacco Curing Rooms, etc.

The instruments described in this bulletin are exclusively of the self-contained type, but there are other Bristol's Recording Wet and Dry-Bulb Thermometers which are made in the long distance type and are described in a separate bulletin.

INSTRUMENT  
Bristol's  
diameter  
calibrated

SENSITIVE BU  
(2) Plain

WATER SUPPL  
(1) Glass

WATER RESER  
Constant

MOTOR  
Standard

Equipment as per  
instrument in  
Same as above with  
Same as above with  
Bristol's Recording  
diameter and  
Bristol's Recording  
diameter and  
Bristol's Recording  
diameter and

INSTRUMENT  
Bristol's  
chart 12-in  
with pens

SENSITIVE BU  
(2) Plain

WATER SUPPL  
(1) Glass

WATER RESER  
Constant

MOTOR  
Standard

Equipment as per  
instrument in  
Same as above with  
Same as above with  
Bristol's Recording  
diameter and  
Bristol's Recording  
diameter and  
Bristol's Recording  
diameter and

The following  
Thermometer.

MODEL—Model

CHART—(a) Size  
(b) Ma  
(c) Av  
(d) Re

CHARACTER OF

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SHIPPING AND



## SPECIFICATIONS AND LIST PRICES FOR MODEL 111

### INSTRUMENT

Bristol's Recording Wet and Dry-Bulb Thermometer Model 111; black enamel finish; chart 12-inches in diameter, arranged for one revolution in twenty-four hours or seven days; two penarms with pens tipped, calibrated to record on same time arc, but not passing each other.

### SENSITIVE BULBS

(2) Plain copper bulbs.

### WATER SUPPLY

(1) Glass Bottle for containing water, mounted in metal bracket with tube to water reservoir.

### WATER RESERVOIR

Constant Level Water Reservoir, with wick for wet-bulb.

### MOTOR

Standard make for all commercial voltages.

Equipment as per above specifications mounted on wooden panel, complete with 100 charts, bottle of special recording instrument ink, padlock and key, and motor for 220 volts A. C. . . . . List Price \$153.00

Same as above with Motor for 110 volts A. C. . . . . List Price \$151.00

Same as above with Motor for D. C., prices quoted on request.

Bristol's Recording Wet and Dry-Bulb Thermometer equipment complete as specified above, but with Chart 8-inches in diameter and Motor for 220 volts A. C. . . . . List Price \$139.00

Bristol's Recording Wet and Dry-Bulb Thermometer equipment complete as specified above, but with Chart 8-inches in diameter and Motor for 110 volts A. C. . . . . List Price \$134.00

Bristol's Recording Wet and Dry-Bulb Thermometer equipment complete as specified above, but with Chart 8-inches in diameter and Motor for D. C., prices quoted on request.

## SPECIFICATIONS AND LIST PRICES FOR MODEL 140

### INSTRUMENT

Bristol's Recording Wet and Dry-Bulb Thermometer Moisture-Proof Model 140; black enamel finish; chart 12-inches in diameter, arranged for one revolution in twenty-four hours or seven days; two penarms with pens tipped, calibrated to record on same time arc, but not passing each other.

### SENSITIVE BULBS

(2) Plain copper bulbs

### WATER SUPPLY

(1) Glass Bottle for containing water, mounted in metal bracket with tube to water reservoir.

### WATER RESERVOIR

Constant Level Water Reservoir, with wick for wet-bulb.

### MOTOR

Standard make for all commercial voltages.

Equipment as per above specifications mounted on wooden panel, complete with 100 charts, bottle of special recording instrument ink, padlock and key, and motor for 220 volts A. C. . . . . List Price \$164.00

Same as above with Motor for 110 volts A. C. . . . . List Price \$162.00

Same as above with Motor for D. C., prices quoted on request.

Bristol's Recording Wet and Dry-Bulb Thermometer equipment complete as specified above, but with Chart 8-inches in diameter and Motor for 220 volts A. C. . . . . List Price \$150.00

Bristol's Recording Wet and Dry-Bulb Thermometer equipment complete as specified above, but with Chart 8-inches in diameter and Motor for 110 volts A. C. . . . . List Price \$145.00

Bristol's Recording Wet and Dry-Bulb Thermometer equipment complete as specified above, but with Chart 8-inches in diameter and Motor for D. C., prices quoted on request.

## DIRECTIONS FOR ORDERING

The following information is necessary to furnish the correct Bristol's Class I Recording Wet and Dry-Bulb Thermometer.

**MODEL**—Model Number 111, or Moisture-Proof Model 140.

**CHART**—(a) Size 12-inch or 8-inch.

(b) Maximum or minimum range required.

(c) Average working range.

(d) Revolution of chart, 24-hour or 7-day.

**CHARACTER OF WORK**—Particular application for which instrument is required.

**MOTOR AND FAN**—State whether Motor is to be operated by D. C. or A. C., if A. C. give frequency. (For satisfactory operation a flow of air over the bulb equal to 12 feet per second is necessary. If the circulation of air is to be accomplished in some other manner, which does not require the Motor and Fan, this should also be stated.)

**SHIPPING AND BILLING**—Give complete instructions for shipping and billing.

MOTION, ETC.



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Bristol's Recording Water Level Gauges

#### TEMPERATURE

Bristol's Class I Recording Thermometers

Bristol's Class II Recording Thermometers

Bristol's Class III Recording Thermometers

Wm. H. Bristol Indicating and Recording Electric Pyrometers

Bristol's Temperature Controllers

#### HUMIDITY

Recording Wet and Dry Bulb Thermometers

#### ELECTRICITY

Bristol's Recording Voltmeters

Bristol's Recording Ammeters

Bristol's Recording Wattmeters

Wm. H. Bristol Recording Milli Voltmeters

Wm. H. Bristol Recording Shunt Ammeters

Bristol's Recording Frequency Meter

#### TIME

Bristol's Electric Time Recorders

#### MOTION

Bristol's Mechanical Time Recorders

#### SPEED

Bristol's Recording Tachometers

#### MISCELLANEOUS

Supplies for Bristol Recording Instruments

Bristol-Durand Radii Averaging Instruments

Gaugeboard Clocks

Bristol Engine Counters

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Bristol Patent Safety Set Screws

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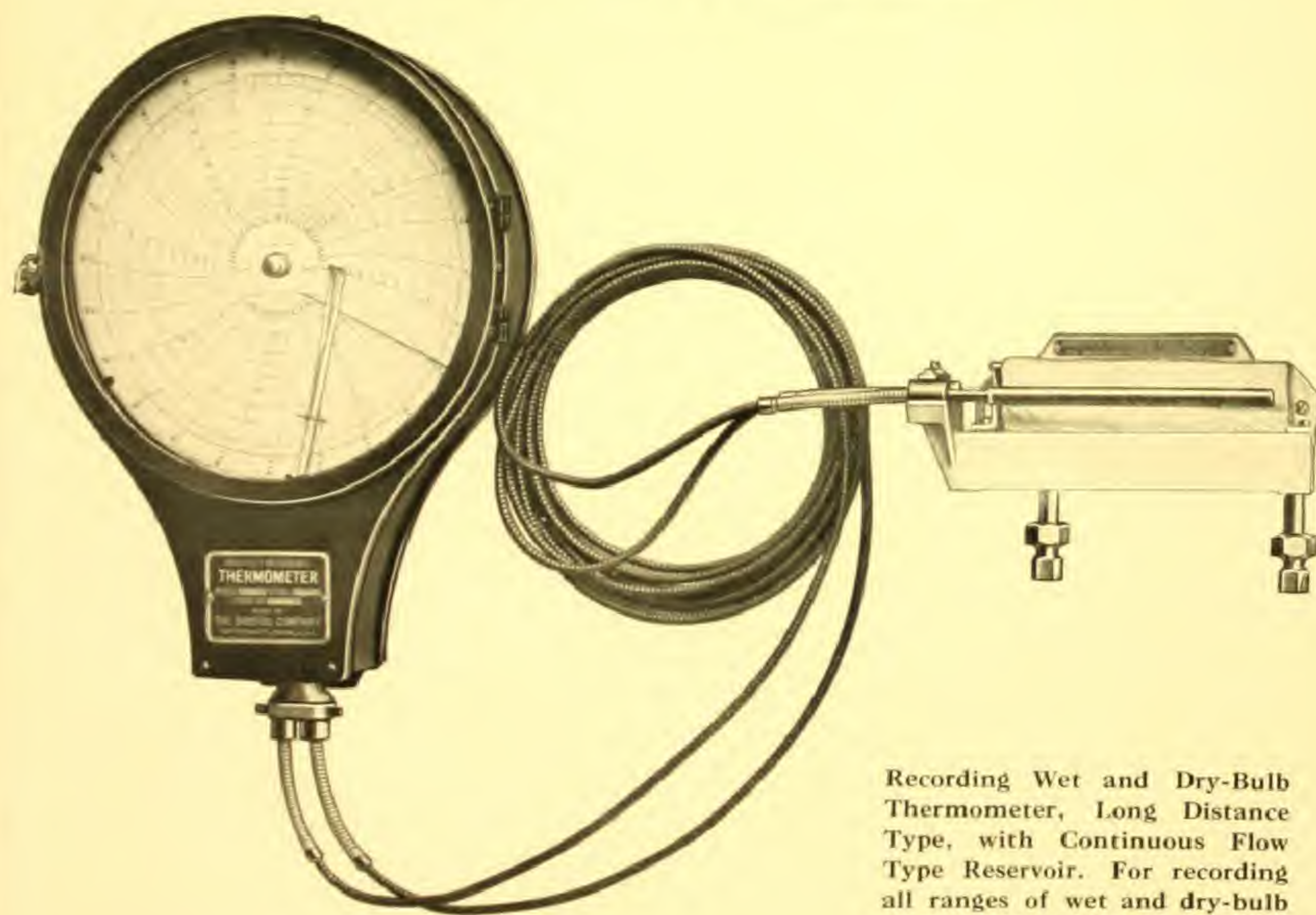
BULLETIN

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No. 311

## BRISTOL'S CLASS II RECORDING WET AND DRY-BULB THERMOMETERS

(Recording Psychrometer or Humidity Recorder)



Recording Wet and Dry-Bulb Thermometer, Long Distance Type, with Continuous Flow Type Reservoir. For recording all ranges of wet and dry-bulb temperatures between 32° and 212° F., from which percent relative humidity can be determined

MOTION, ETC.



## BRISTOL'S RECORDING WET AND DRY-BULB THERMOMETERS

(Recording Psychrometer or Humidity Recorder)

There are many processes in the industrial plants where the success of the operation depends largely upon the surrounding atmospheric humidity. The importance of this fact has induced builders of humidifying apparatus to make great progress in equipment to secure just the right conditions. Such apparatus is useless, however, without some means of checking its operation in regard to the result desired. In order to secure close control it is necessary to have some means of knowing, at all times, just what the humidity conditions are. To take care of this requirement The Bristol Company has developed and perfected a reliable instrument to record Wet and Dry-Bulb temperatures, from which relative humidity or atmospheric moisture may be figured. This instrument is known as the "Recording Wet and Dry-Bulb Thermometer" or "Recording Psychrometer" and is described in this bulletin.

Bristol's Recording Wet and Dry-Bulb Thermometer shown here is an adaption of the standard two-pen Bristol's Vapor Pressure, or Class II Recording Thermometer with adjusted bulb. This type of instrument is noted for simplicity of construction, accuracy and sensitivity in operation. They can be calibrated for practically all ranges between freezing and the boiling point of water. The instrument has two complete operating systems, including two bulbs and two pens; both pens recording on the same chart. One system records the temperature of the dry-bulb, or atmosphere; the other the temperature of a bulb kept constantly moist, and known as the wet-bulb.

The operation of Bristol's Recording Wet and Dry-Bulb Thermometer is based on the principle that evaporation varies with the amount of moisture in the atmosphere. The temperature of the wet-bulb is always lower than the surrounding atmosphere. The difference in the temperature readings of the wet-bulb and dry-bulb is known as the wet-bulb depression. This varies directly with the rate of evaporation, which rate is inversely proportional to the amount of water vapor in the air, at the indicated atmospheric temperature. By taking the dry-bulb temperature and noting the wet-bulb depression, the relative humidity in percent can be readily ascertained from the table as shown on page 11.

A flexible capillary tubing connects the sensitive bulbs and the instrument. This Long Distance Feature permits the instrument and bulb to be installed several feet apart. It is the temperature at the sensitive bulb which is recorded on the instrument. Any changes in temperature along the connecting tube do not affect the accuracy of the equipment. The bulbs are usually located in the kiln, drying room, etc., while the instrument is outside at a convenient place for observation and necessary attention. The standard length of tubing is 25-feet, any other length desired must be so specified.

The bulbs are mounted on a Water Reservoir of the Continuous Flow Type. This is an exclusive Bristol's feature, and illustrated in Figure 1779. The reservoir is made of aluminum, therefore, it will not rust. The design and construction permits the bulb to be supported in such a manner that the sensitive portions do not come in contact with any metal of the reservoir. Thus, when rapid fluctuations of temperature take place, the readings recorded are in no way

affected by the  
mersed in bot  
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Figure 1778 o

To secure  
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In addition  
Bulb Thermom  
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The follow  
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especially high  
Drying and V  
Storage Rooms  
and curing fish  
for experiments



## CONTINUOUS-FLOW TYPE WATER RESERVOIR

### USED WITH BRISTOL'S WET AND DRY-BULB THERMOMETERS

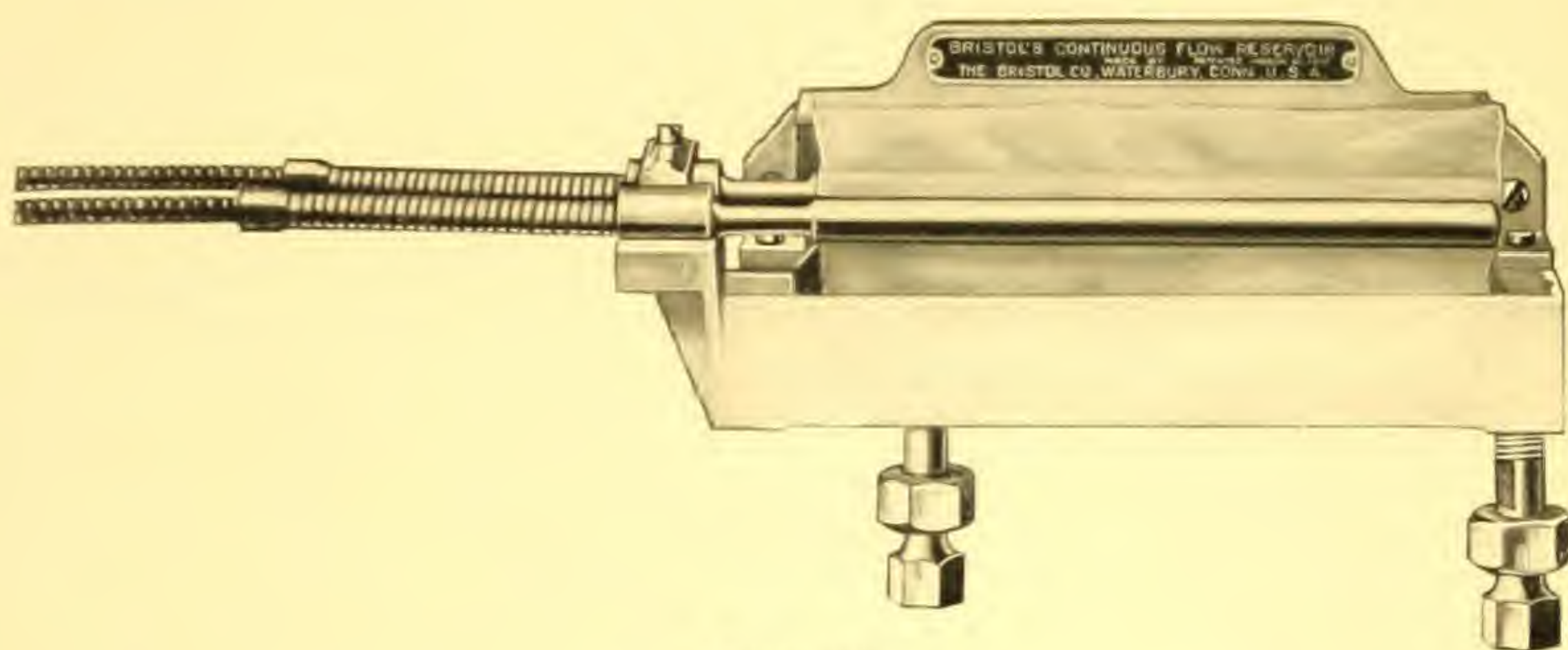


Figure 1779

affected by the temperature of the metal reservoir. A wick fits over the wet-bulb, and is immersed in both the upper and lower reservoirs. With this arrangement, even at high rates of evaporation the bulb is always kept wet, and the wick remains clean for a much longer time than with the more common types of water reservoirs. The dry-bulb is at one side, sufficiently distant to be unaffected by the evaporations. Details of the reservoir are shown in line sketch Figure 1778 on page 6.

To secure satisfactory results from Bristol's Recording Wet and Dry-Bulb Thermometers it is necessary that there is a flow of air over the wet-bulb of at least 12-feet per second. As nearly all installations of wet and dry-bulb thermometers are made in air ducts, dry kilns, etc., where induced air currents already exist, it is not usually necessary to supply other means. However, where required, attachment including motor and fan can be furnished.

In addition to the two models illustrated in this bulletin, Bristol's Recording Wet and Dry-Bulb Thermometer can be furnished mounted in a Moisture-Proof case; also the inverted type of movement; i. e., with penarm operating from the top, can be supplied when desired.

The following are a few of the places where Bristol's Recording Wet and Dry-Bulb Thermometers are used to help secure close control of humidity conditions: Dry Kilns for wood, especially high-grade hard wood—Drying of Clay products, particularly glazed ware—Textile Drying and Weaving Rooms in Silk Mills—Rooms where Kodak Films are made—Powder Storage Rooms in Powder Mills—Tobacco Curing Rooms—in Canneries for Dehydrating Fruits and curing fish and meats—Ventilating Ducts in Schools and Public Buildings—Laboratories for experimental work etc.



## BRISTOL'S RECORDING WET AND DRY-BULB THERMOMETER MODEL 211

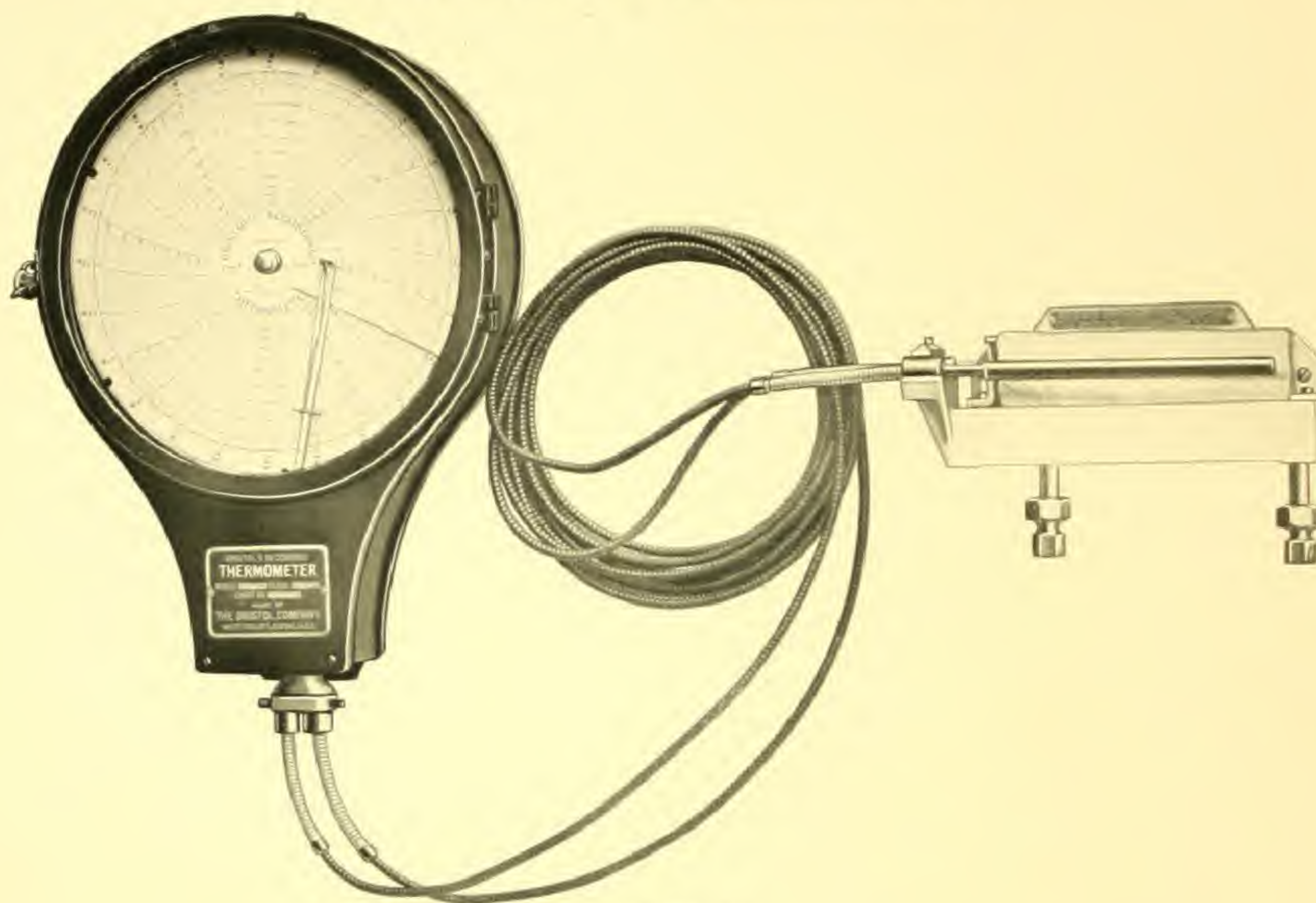


Figure 1780

This model is called Bristol's Original Form. The working element of instrument was designed first, and then the case modeled to fit it. The advantage of this naturally suggests itself; i.e., in the absolute freedom of operating parts. This is especially important owing to the fact that there are two complete recording systems in the Wet and Dry-Bulb Thermometers.

Charts used with this model are 12-inches in diameter, which supplies a very open and easily read record. See full size specimen of 12-inch chart on pages 8 and 9. These charts can be furnished to make one revolution in 24-hours or 7-days as required.

### SPECIFICATIONS AND LIST PRICE

#### INSTRUMENT

Bristol's Recording Wet and Dry-Bulb Thermometer Model 211; black enamel finish; chart 12-inches in diameter, arranged for one revolution in 24-hours or 7-days; two penarms with pens tipped, calibrated to record on same time arc, but not passing each other.

#### SENSITIVE BULB

(2) Plain copper bulbs adjusted type, 8-inches long,  $\frac{3}{4}$ -inch in diameter, 7-inches sensitive portion.

#### CONNECTING TUBE

(2) Connecting tubes, 25-feet long, with flexible bronze armor protection.

#### WATER RESERVOIR

Continuous Flow Water Reservoir, with wick for wet-bulb, and arranged for direct connection to water supply.

The equipment as per above specifications complete with 100 extra charts, bottle of special recording instrument ink, padlock and key. List Price \$160.00



## BRISTOL'S RECORDING WET AND DRY-BULB THERMOMETERS MODEL 261

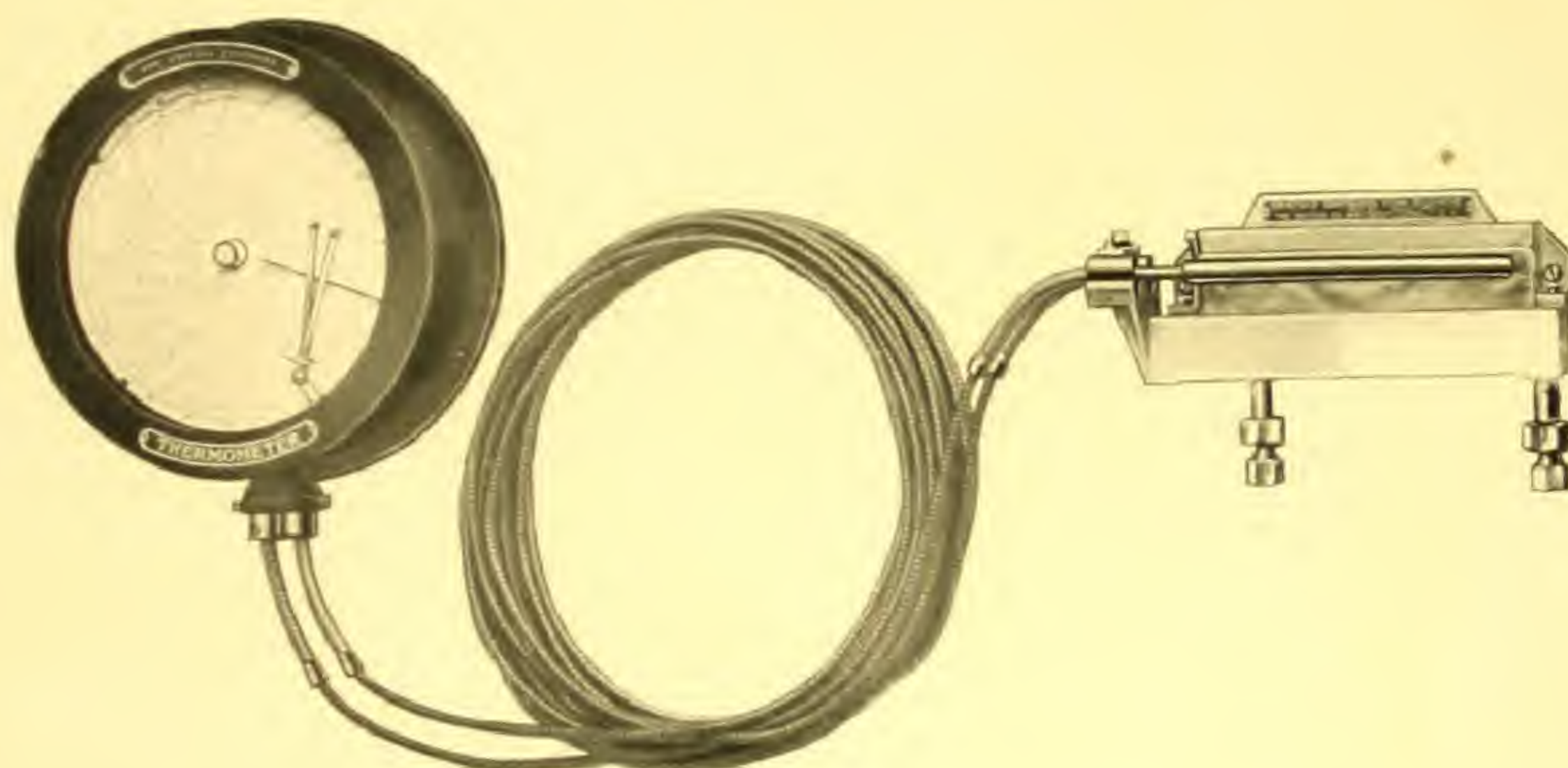


Figure 1805

For some applications the more conventional Round Form case is desired. To take care of such requirements, the Model 261 is available. The price of this instrument is somewhat lower than Original Form Model 211, yet it embodies the features which make it desirable and durable instrument where the Round Form case is required.

Charts 8-inches in diameter are used with Model 261. See full size specimen on page 10.

The instrument above is shown complete with 25-feet flexible connecting tube and sensitive bulbs mounted on continuous flow type water reservoir.

### SPECIFICATIONS AND LIST PRICE

#### INSTRUMENT

Bristol's Recording Wet and Dry-Bulb Thermometer Model 261; black enamel finish; chart 8-inches in diameter, arranged for one revolution in 24-hours or 7-days; two penarms with pens tipped, calibrated to record on same time arc, but not passing each other.

#### SENSITIVE BULB

(2) Plain copper bulbs adjusted type, 8-inches long,  $\frac{1}{8}$ -inch in diameter, 7-inches sensitive portion.

#### CONNECTING TUBE

(2) Connecting tubes, 25-feet long, with flexible bronze armor protection.

#### WATER RESERVOIR

Continuous Flow Water Reservoir, with wick for wet-bulb, and arranged for direct connection to water supply.

The equipment as per above specifications complete with 100 extra charts, bottle of special recording instrument ink, padlock and key. . . . . List Price \$120.00

MOTION, ETC.



## DETAILS OF BRISTOL'S CONTINUOUS FLOW TYPE RESERVOIR

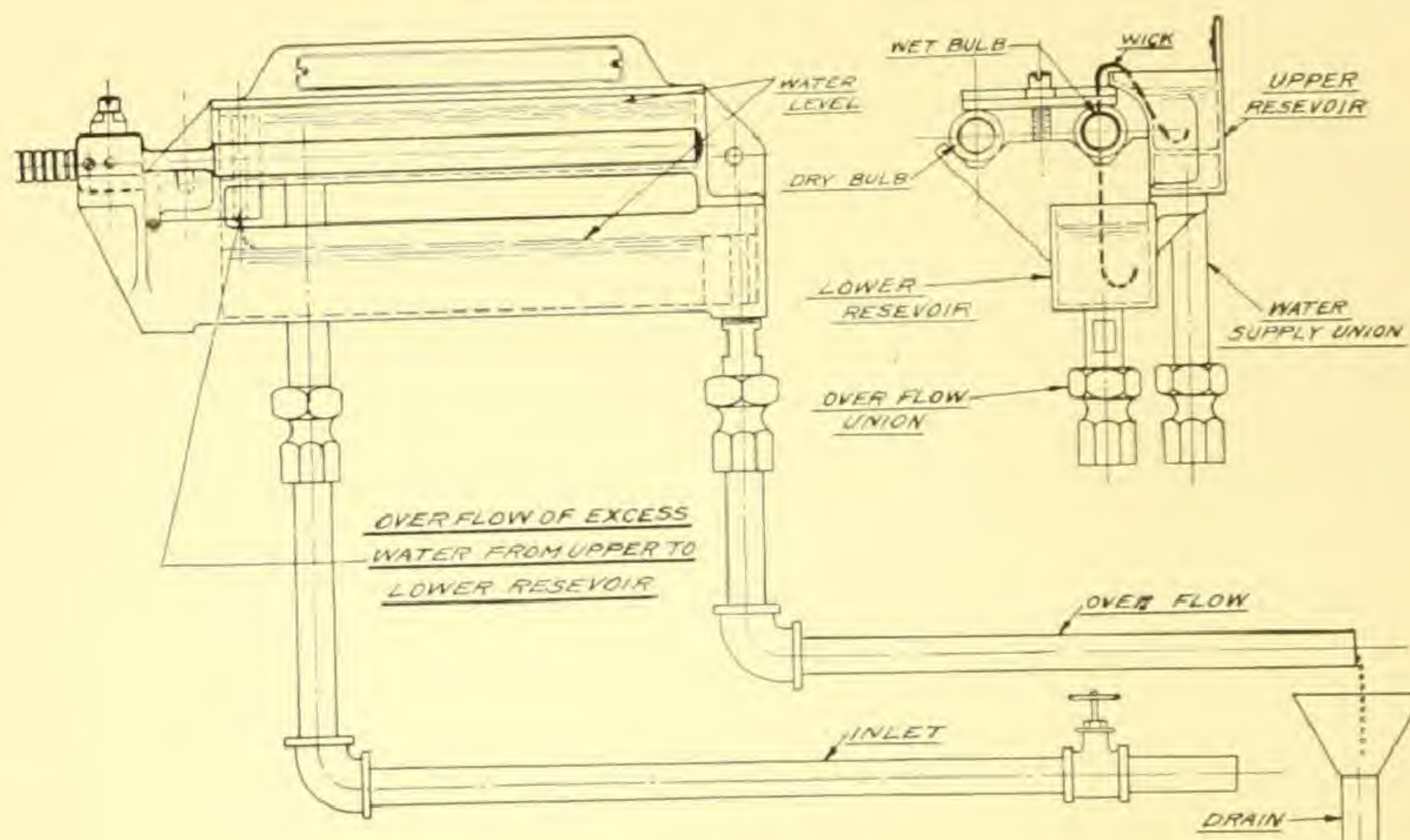


Figure 1778

Details of Bristol's Continuous Flow Type Reservoir are shown in the above line-sketch, Figure No. 1778. This fixture supports both wet-bulb and dry-bulb in such a manner that the sensitive portion of the bulbs do not come in contact with any metal of the reservoir. This fact prevents the readings on the instrument from being influenced by the temperature of the metal reservoir. The dry-bulb is at one side sufficiently distant not to be affected by evaporation of the wet-bulb.

There are two water reservoirs, upper and lower. The union marked WATER SUPPLY leads directly to the upper reservoir, and should be connected with a permanent water supply. The flow of water is regulated by a valve in the line, and should be just sufficient to maintain a constant level in both upper and lower reservoirs. This makes it important that the reservoirs be installed in a level position. The union marked OVERFLOW leads from the lower reservoir and should be connected to a drainage system.

A wick fits over the wet-bulb and extends to both the upper and lower reservoirs. The flow of water causes a continuous film to be maintained over the surface of the wick, and insures a permanently moist and clean wet-bulb.

The water supply in some localities contains minerals such as lime, which cause the fixture to clog and the fabric of the wick to deteriorate. Where such conditions exist, it is advisable to use condensed water. Sometimes dust and grease collect from the surrounding atmosphere, and sedimentary deposits from the water cause the wick to become clogged. This makes it necessary to occasionally remove the wick, thoroughly wash or renew it. Periodical examination of the wick and fixture should be made at least every two or three weeks to make sure that they are clean and in good condition.



## HOW TO USE

### Wet and Dry-Bulb Recording Thermometer to Obtain Relative Humidity

In applying "Bristol's Recording Wet and Dry-Bulb Thermometer" to obtain percent of relative humidity: take the reading of the wet-bulb pen and dry-bulb pen at any certain time. Subtract the reading of the wet-bulb from that of the dry-bulb. The result is the wet-bulb depression. Referring to the Relative Humidity Table given on page 11, at top of table find the column corresponding nearest to the wet-bulb depression and run down vertical column to intersection of horizontal line opposite the nearest to dry-bulb temperature. The figure at the intersection is the percent relative humidity or saturation.

To illustrate with an actual case: refer to chart on page 10 select time at 11:30 P.M. for which the dry-bulb temperature is  $114^{\circ}$  and the wet-bulb  $92^{\circ}$ . The difference between the dry-bulb and wet-bulb is  $22^{\circ}$ , which represents the wet-bulb depression. Using the table on page 11 find in the top line the Wet-Bulb Depression nearest to  $22^{\circ}$ ; in this instance it is exactly  $22^{\circ}$ . Follow down the vertical column to horizontal line nearest to  $114^{\circ}$  dry-bulb temperature; which is  $115^{\circ}$ . At the intersection of these two lines is  $43^{\circ}$ , which is the percent relative humidity.

Time 11:30 P.M.	
Dry-Bulb Temperature.....	$114^{\circ}$
Wet-Bulb Temperature.....	$92^{\circ}$
Wet Bulb Depression.....	$22^{\circ}$
Percent Relative Humidity.....	$43\%$

## DIRECTIONS FOR ORDERING

The following information is necessary to furnish the correct Bristol's Recording Wet and Dry-Bulb Thermometer.

MODEL—Model Number 211, 261 or Moisture-Proof Model 240

CHART—(a) Size 12-inch or 8-inch  
(b) Maximum and minimum range required  
(c) Average working range  
(d) Revolution of chart, 24-hour or 7-day

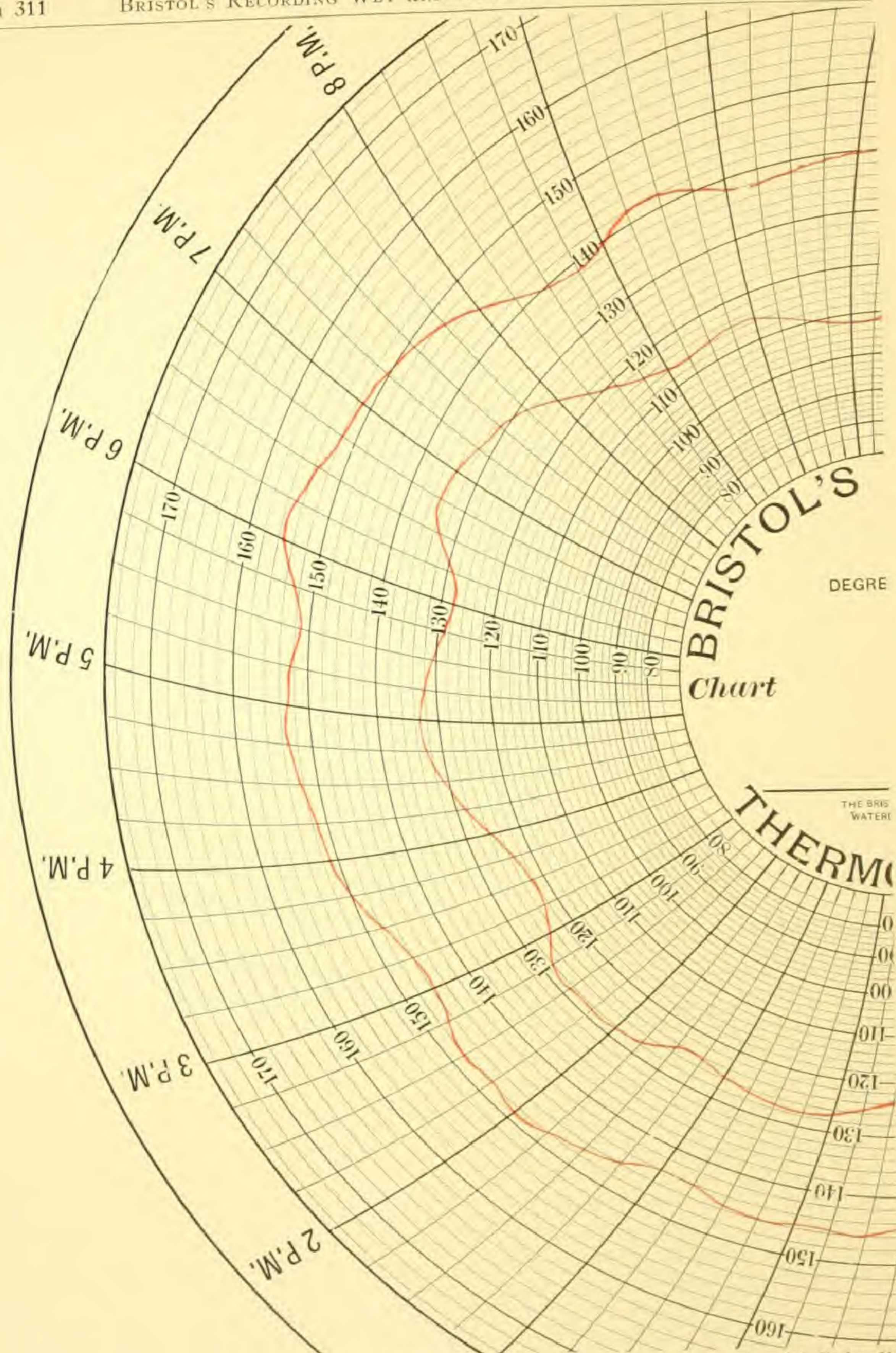
CHARACTER OF WORK—Particular application for which instrument is required.

MOTOR AND FAN—A flow of air over the bulb equal to 12-feet per second is necessary for satisfactory operation of Wet and Dry-Bulb Thermometer. If this is not already available a Motor and Fan is required to be supplied with the instrument.

In case Motor and Fan is to be furnished, state whether it is to be operated by D.C. or A.C., if A.C. give frequency.

SHIPPING AND BILLING—Give complete instructions for shipping and billing.





Specimen Record on 12-Inch Chart made with Bristol's

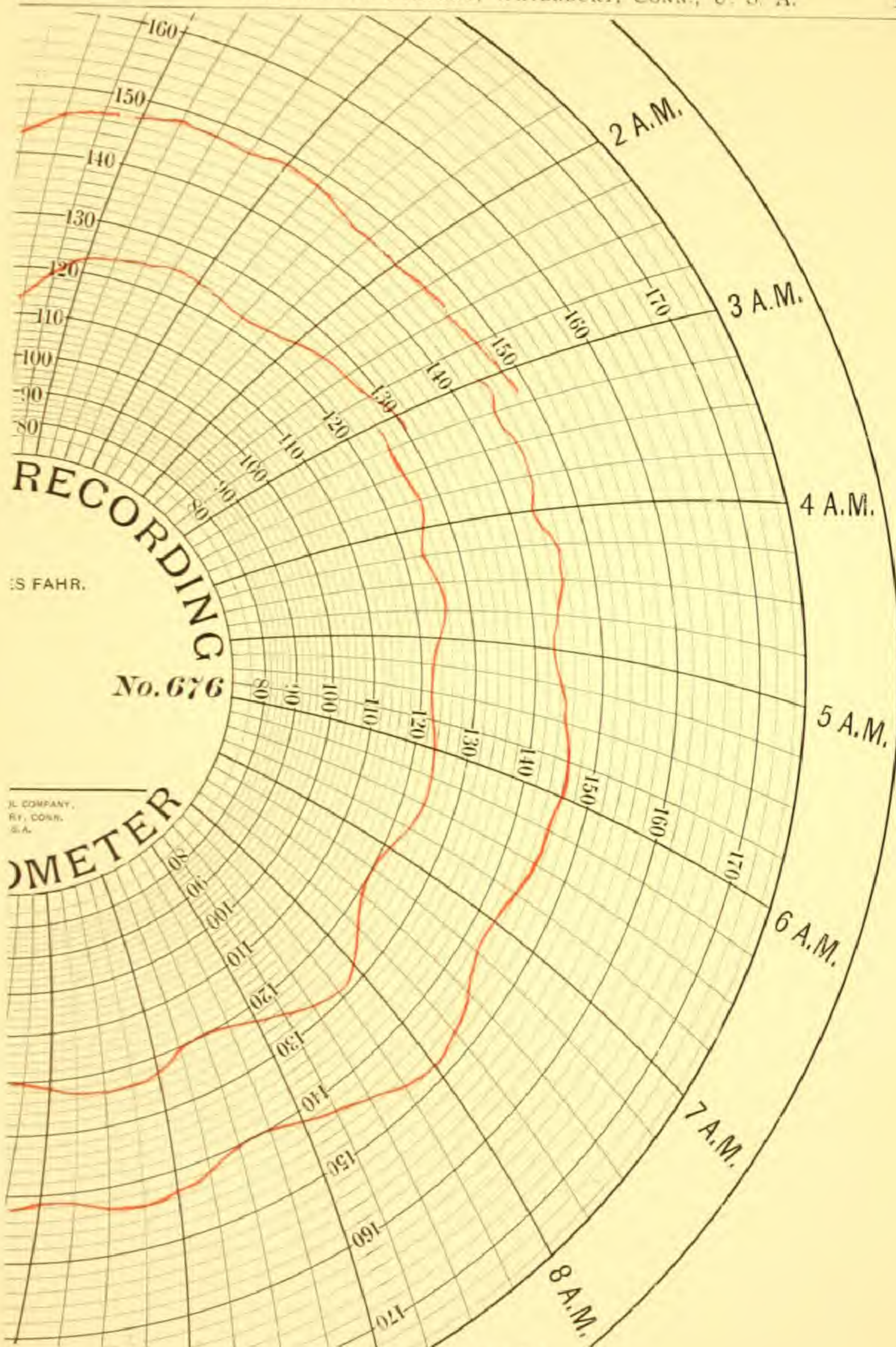


5 FAHR.

OMETE

Recording Wet





THE BRISTOL COMPANY,  
WATERBURY, CONN., U. S. A.

Recording Wet and Dry-Bulb Thermometer Model 211.

MOTION, ETC.



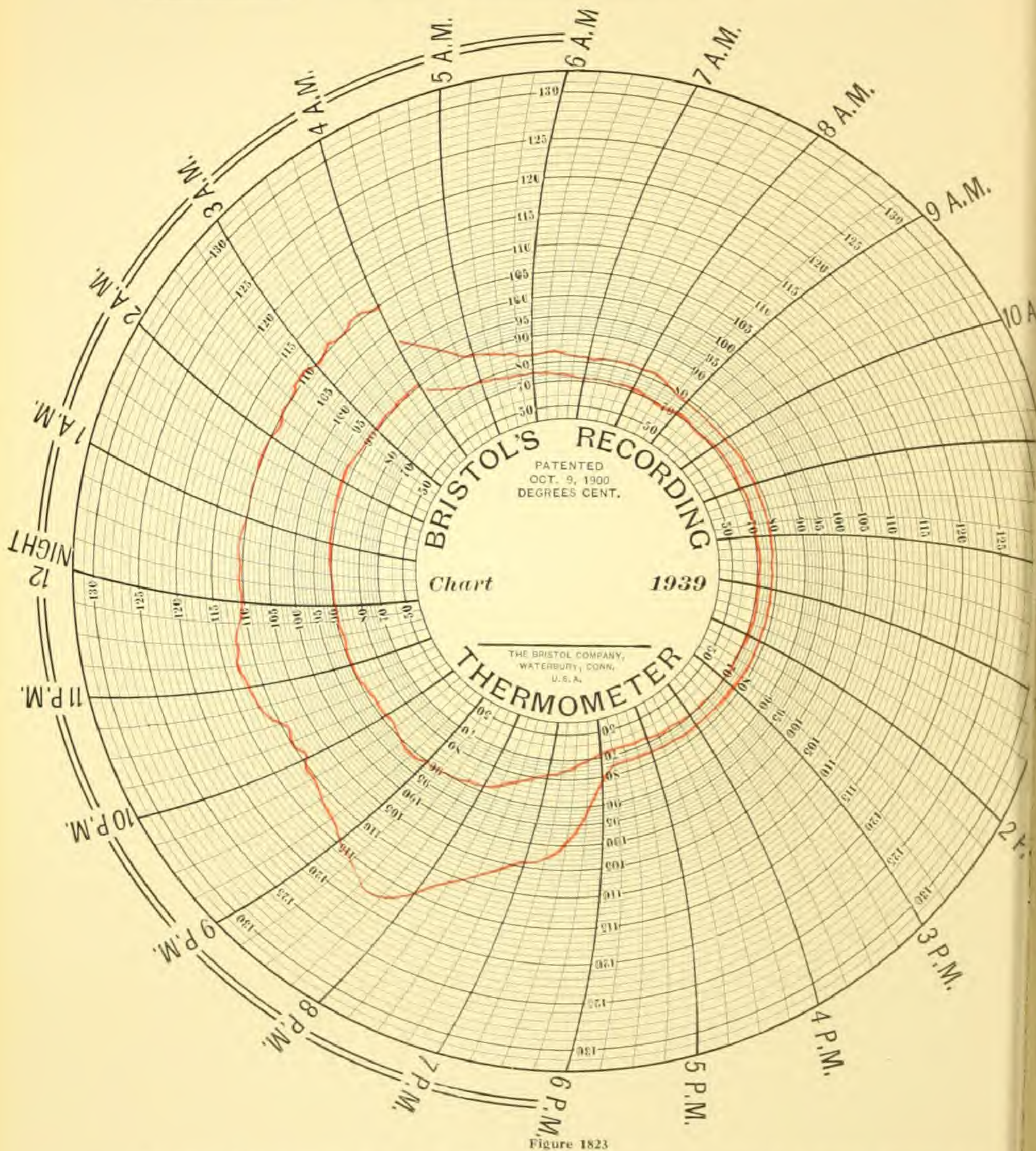


Figure 1823

Specimen 8-Inch Chart Record of Wet and Dry-Bulb temperatures in Varnish Drying Kiln, made with Bristol's Recording Wet and Dry-Bulb Thermometer.



## RELATIVE HUMIDITY TABLE

[illegible]

**MOTION, ETC.**



TRADE MARK  
**BRISTOL'S**  
 REG. U. S. PAT. OFFICE.



## THE BRISTOL COMPANY

Main Office and Factory  
 WATERBURY, CONN., U. S. A.

BRANCH OFFICES:				
BOSTON	NEW YORK	PHILADELPHIA	BIRMINGHAM	PITTSBURGH
Old South Bldg.	114 Liberty St.	Widener Bldg.	Age-Herald Bldg.	Frick Bldg.
DETROIT	CHICAGO	ST. LOUIS	DENVER	SAN FRANCISCO
Book Bldg.	Monadnock Block	Boatmen's Bank Bldg.	U. S. National Bank Bldg.	Rialto Bldg.

### THE MOST EXTENSIVE LINE OF RECORDING INSTRUMENTS IN THE WORLD

#### PRESSURE AND VACUUM

Bristol's Recording Pressure and Vacuum Gauges

#### LIQUID LEVEL

Bristol's Recording Water Level Gauges  
 Bristol-Derr Water Level Gauges for Steam Boilers

#### TEMPERATURE

Bristol's Class I Recording Thermometers  
 Bristol's Class II Recording Thermometers  
 Bristol's Class III Recording Thermometers  
 Wm. H. Bristol Indicating and Recording Electric Pyrometers  
 Bristol's Temperature Controllers

#### HUMIDITY

Recording Wet and Dry Bulb Thermometers

#### ELECTRICITY

Bristol's Recording Voltmeters  
 Bristol's Recording Ammeters  
 Bristol's Recording Wattmeters  
 Wm. H. Bristol Recording Milli Voltmeters  
 Wm. H. Bristol Recording Shunt Ammeters  
 Bristol's Recording Frequency Meter

#### TIME

Bristol's Electric Time Recorders

#### MOTION

Bristol's Mechanical Time Recorders

#### SPEED

Bristol's Recording Tachometers

#### MISCELLANEOUS

Supplies for Bristol Recording Instruments  
 Bristol-Durand Radii Averaging Instruments  
 Gaugeboard Clocks  
 Bristol Engine Counters  
 Bristol Revolution Counters  
 Bristol Patent Safety Set Screws

**Bristol's Patent Steel Belt Lacing—The Perfect Fastener for All Kinds of Belts**



MOTION, ETC.







# BRISTOL'S

## (MECHANICAL)

## MOTION

AND

5 PM

## (ELECTRICAL)

## OPERATION

# RECORDER



BRISTOL'S TIME RECORDER  
MADE BY  
THE BRISTOL CO. WATERBURY, CONN., U.S.A.





*In a marble works plant five Electric Operation Recorders are used to furnish information as to the operation of saw and planer, polishing and turning lathes, gang saws, rubbing beds and polishing machines.*



## Bristol's (Mechanical) Motion and (Electrical) Operation Recorders

**T**O furnish automatic records of mechanical operations is the purpose of the recording instruments described in this catalog. Two types of instruments are shown as outlined below.

First, the Mechanical Motion Recorder which automatically records the actual operation—the time of operation—and the extent of mechanical movement. It is called Mechanical Motion Recorder because the principle of operation is entirely mechanical. These instruments are furnished in Round Chart and Strip Chart models.

Second, the Electric Operation Recorder. This, as the name implies, is operated electrically, and in contrast to the mechanical motion recorder, it records—the fact of operation—time of operation—and the duration of same.

The Electric Operation Recorders can be furnished in Round Chart or Strip Chart models. The Round Chart instruments are made to record one operation or any number of operations up to twelve on one chart; while the Strip Chart model can be furnished to record five, ten, fifteen or even twenty different operations on the same chart.

The instruments described in this catalog are used on all kinds of industrial operations, and have an almost unlimited number of applications including: operations of Machinery, Elevators and Hoists, Conveyors, opening and closing of Doors, Gates, Valves, etc.

The Mechanical Motion or Electrical Operation Recorders can be used in connection with Bristol's Long Distance Transmitting System to transmit the records from the source of operation to a distant location of even several miles. Such an equipment is often used in connection with opening and closing of gates of spillway at reservoirs.

## THE BRISTOL COMPANY

Main Office and Factory  
WATERBURY, CONNECTICUT

### BRANCH OFFICES:

BOSTON  
Consolidated Bldg.

NEW YORK  
114 Liberty Street

PHILADELPHIA  
Widener Bldg.

BIRMINGHAM  
Age - Herald Bldg.

PITTSBURGH  
Frick Bldg.

DETROIT  
Book Bldg.

CHICAGO  
Monadnock Bldg.

ST. LOUIS  
Boatmen's Bank Bldg.

DENVER  
U. S. Nat. Bank Bldg.

SAN FRANCISCO  
Rialto Bldg.



## The Instrument

### (MECHANICAL) MOTION RECORDER

#### MODEL 911

This Mechanical Motion Recorder records not only the fact of operation, but also the time and extent of movement.

Such an instrument furnishes valuable information for many important mechanical operations, some of which are: Sluice Gates for Turbines, movement of Gas Holder, rise and fall of Hydrometer, movement of Alternating Current Feeder Regulator, operation of Valves, movement of Plunger Feeder, movement of Elevator and Cars, reversal of Open Hearth Furnace, operation of Automatic Weighing Machines, operation of Conveyors, opening and closing of Gates for Water Wheel, Crushing Machine in Mines, Belt Conveyor, variation in Water Level at Water Works with Float, depth and motion of Dredge, timing Centrifugal Wringers, Beater in Pulp Mill, Engine Governors, Pulp Grinders, movement of Damper Opening.

The construction of the instrument is extremely simple. The lever arm shown in the illustration, passes through a slot in the bottom of case and is attached to the penarm, which records directly on the revolving chart. Because there is no complicated mechanism to get out of order, such an equipment will operate for years without repairs or adjustments.

When installing the instrument for use, connection is made with the lever arm. The standard length of lever arm is 14 inches and is adjustable down to 2 inches. It is also adjustable to any position within an angle of 180 degrees. However, when using the full



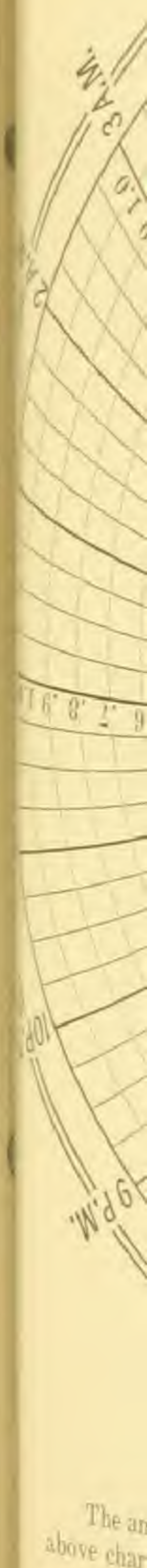
length of the lever arm, at the end a 5-inch motion of full scale deflection can be secured. The motion to be recorded can, if necessary, be reduced or multiplied by use of pulleys, levers, or other reducing or multiplying devices. See diagrams on page 10 showing how instruments have been installed for some applications.

If instrument is to be installed where atmospheric conditions are unusually damp or dusty, a more rugged case Model 940 can be furnished. This case is rectangular in shape, made of cast iron and gasketed. The lever connection on this model is made at the back instead of the bottom.

Instrument Model 911 illustrated, or Model 940 can be furnished in two sizes having charts 12 inches or 8 inches. The standard finish for case of both models is black enamel.

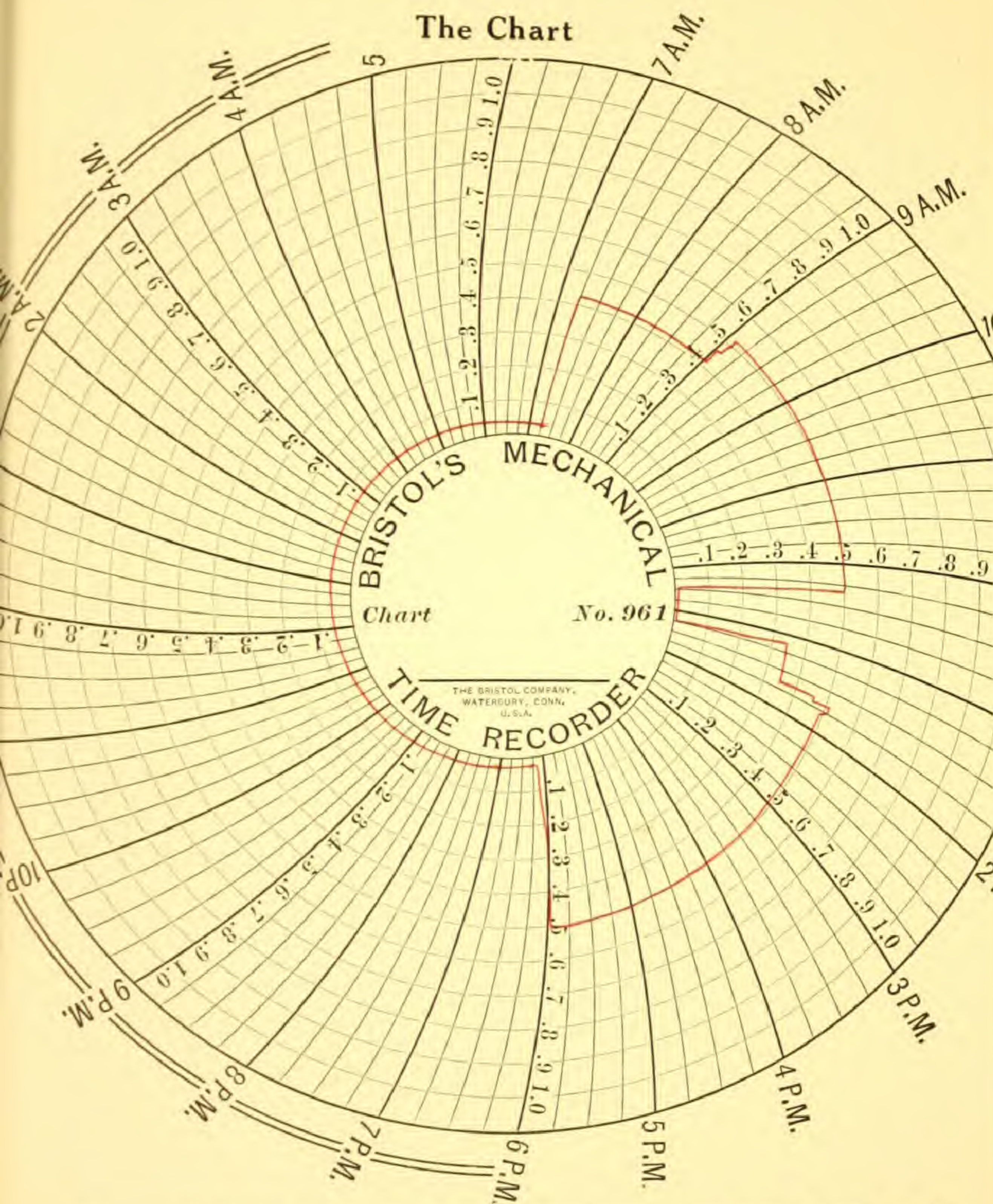
For some places it is desirable to have an instrument with inverted penarm. That is, penarm operating from the top instead of upright position as illustrated here. Models 911 and 940 can be furnished with inverted penarm at the same price as upright.

In addition to the Mechanical Motion Recorder Instrument using round chart, a similar equipment can be furnished with strip chart. In appearance it is like the Electric Operation Recorder shown on page 8. Such an instrument will give a continuous record for 45 days without changing chart.



The an  
above char





The amount of water, and the time it passed through water wheel gate, is shown by the above chart record made with Bristol's Mechanical Motion Recorder at a large Textile Mill.



## The Instrument

### (ELECTRICAL) OPERATION RECORDER



### ELECTRICAL OPERATION RECORDER MODEL 911

This model of instrument can be furnished with one penarm or any number up to twelve. Instrument at left is shown with one penarm; instrument at right with six.



The fact of operation—time of operation—and the duration are recorded by Bristol's Electric Operation Recorders.

One superintendent of a paper mill remarked: "The Electric Operation Recorder is used by us to register the operation on six paper machines. This chart shows us each morning how long each machine was stopped during the previous 24 hours and the number of breaks occurring in the sheet of paper."

In every industrial plant there are certain machines or mechanical operations on which it is desirable to have a constant check. Many important uses will suggest themselves to any superintendent or engineer who considers the fact that Bristol's Electric Operation Recorders can be used to record any mechanical operation or movement from which a simple contactor can be operated. See page 15 for Electrical Contactor often used for this purpose.

The Electric Operation Recorders Model 911 illustrated above can be furnished in two sizes, having charts 12 inches or 8 inches in diameter. The 12-inch size can be equipped with from one up to twelve penarms to record as many different operations on the same chart, while the 8-inch size can be used with from one to six penarms.

This same model, either size, can be furnished with inverted penarm when desired, at no change in price.

Because this instrument is electrically operated does not make it a complicated equipment. Each penarm is an independent unit and is operated by an individual electric magnet and circuit. The necessary electric current may be supplied from batteries or lighting circuit. See wiring diagrams on page 14.

The electrical feature permits the instrument to be installed a long distance from the operation to be recorded. It is only necessary to run wires between the two locations. The distance may be even several thousand feet.

For use in locations where there is an unusual amount of dampness, dust or dirt, a more rugged case Model 940 is recommended. This case is rectangular in shape, made of cast-iron and gasketed, so that it is dust-proof and moisture-proof. It uses the same round charts as Model 911.

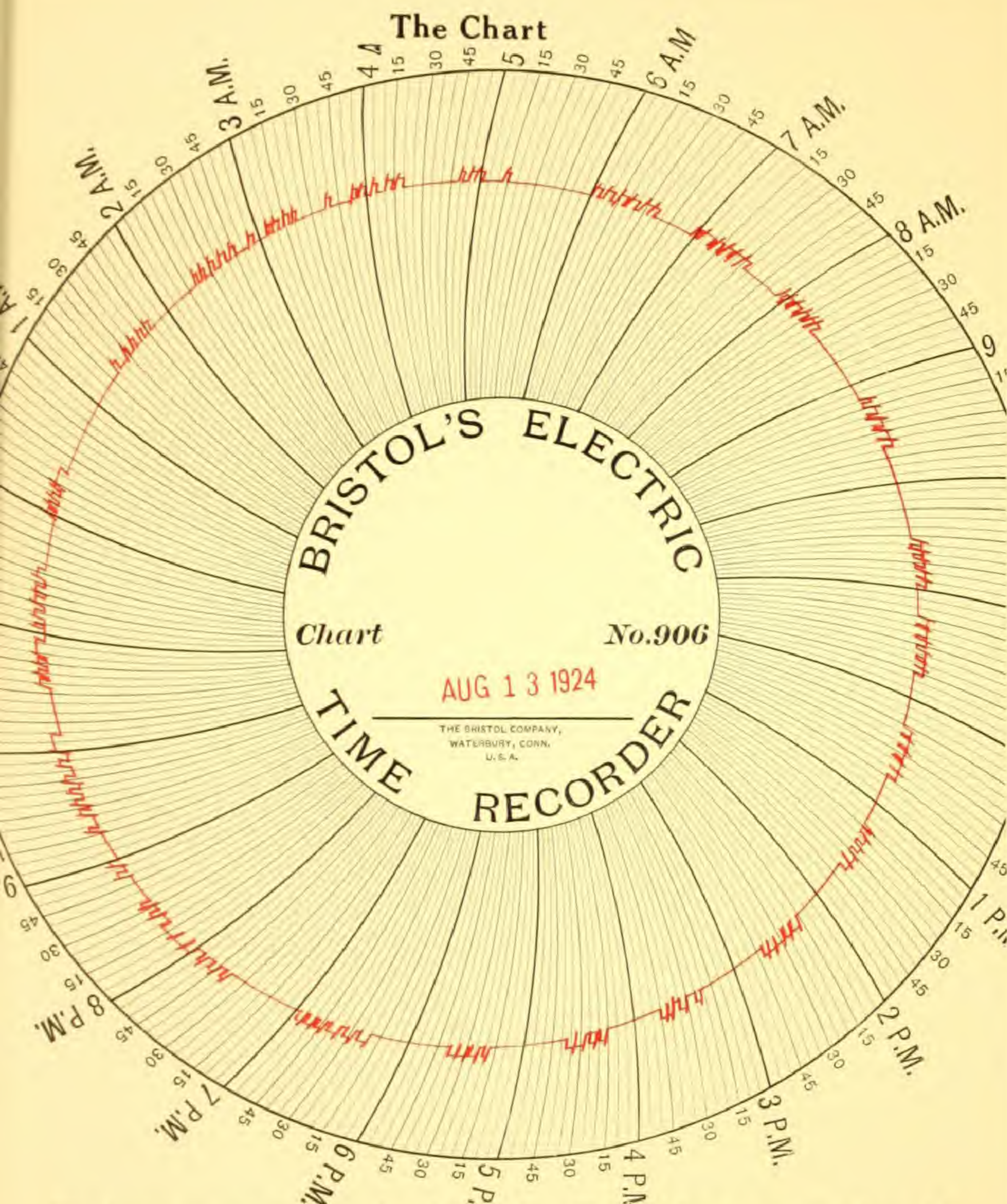
Standard finish for cases of both Models 911 and 940 is black enamel.

On page 11 are diagrams showing how the instruments have been installed for a few applications.



The ab  
as pulled  
connectio





The above chart record shows cakes of ice as pulled from ice tank. It is operated in connection with electric hoist used to lift the

ice. The recording instrument is located in the office across the road from ice-making plant.



**The Instrument**  
**"STRIP CHART"**  
**ELECTRIC OPERATION RECORDER**  
**MODEL 925**



This instrument uses a straight or strip chart which furnishes a continuous unbroken record over a period of several days. The chart is 90 feet long and when operated at a speed of 1 inch per hour will provide a record for 45 days. Faster speeds of 3 inches and 6 inches per hour are also available.

The records on the strip chart appear in parallel form which is a ready means of comparing several different operations. The chart as it comes from the instrument is rolled up, which is a convenient form for filing and future reference. However, when desired any portion of the chart may be cut off.

The illustration shows the instrument equipped with 20 penarms which record

twenty different operations on one chart, but may also be furnished with 5, 10 or 15 pens as required.

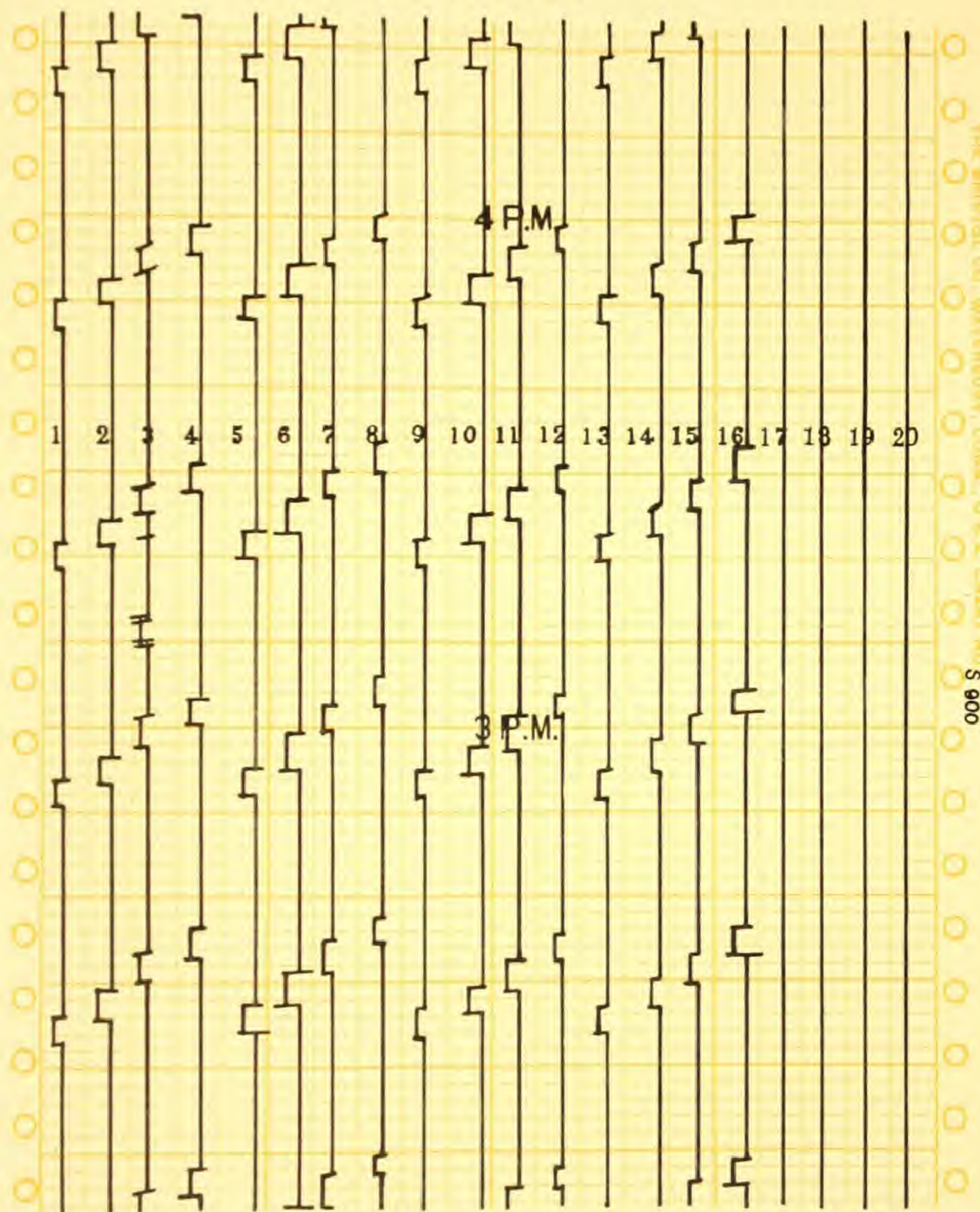
Connections can be made either at the bottom or back. The back connection is the one generally used for switchboard installation.

Hundreds of different operations in many different classes of industries are being recorded with Bristol's Electric Operation Recorders, a few of which are: the operation of Valves, Switches, Pumps, Railroad Trains, Elevators, Coke Ovens, Reversal Valves of Open Hearth Furnaces, Paper Machines, Weighing Machines, Cement Kilns, Trolley Cars, Railway Switches, Tilt Traps, etc.

Full s  
record n  
Electric  
shows th  
presses i



## The Chart

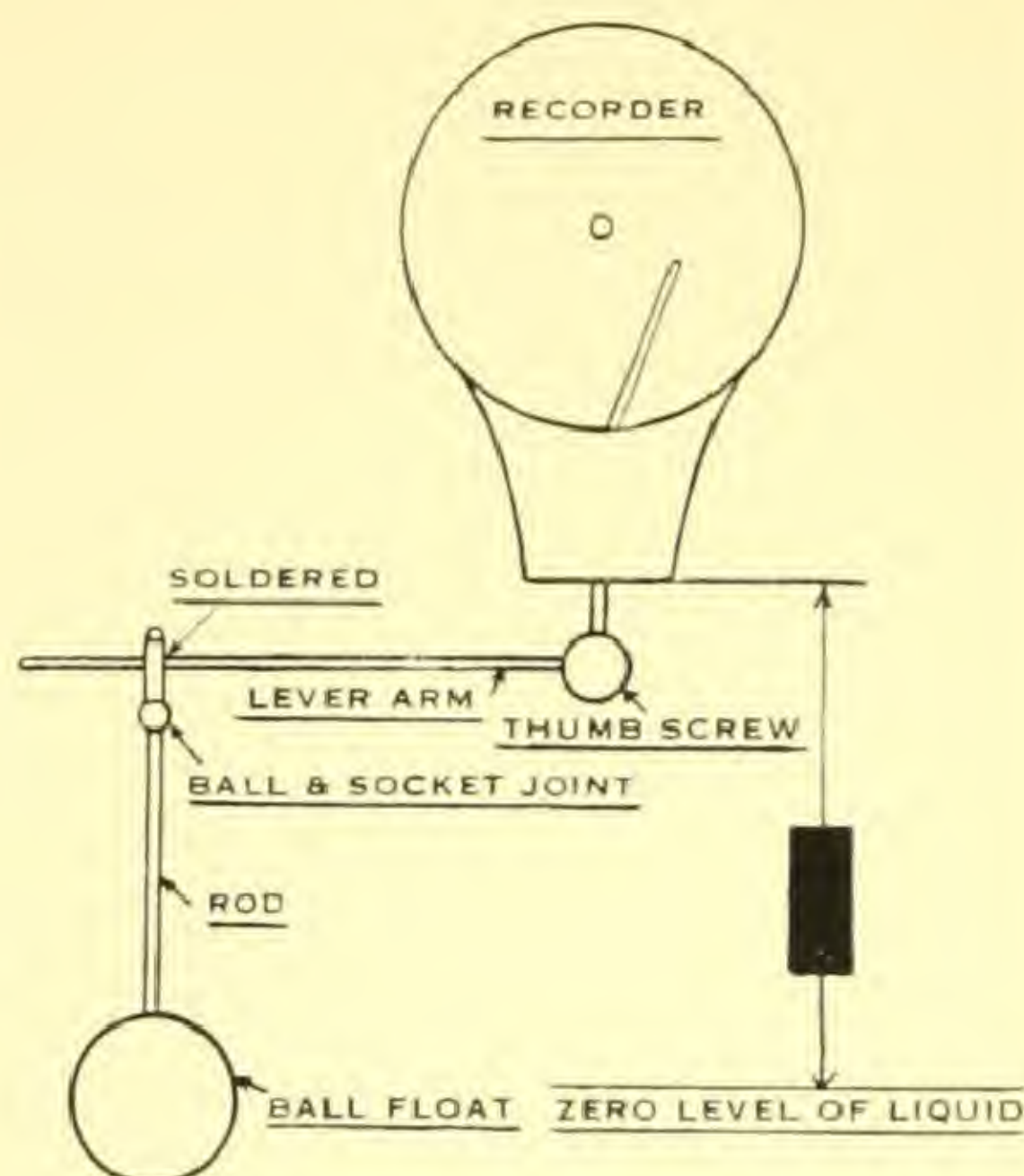


Full sized specimen section of chart with record made by a twenty-pen Strip Chart Electric Operation Recorder. The record shows the operation of twenty bicycle tire presses in a large rubber works plant. From

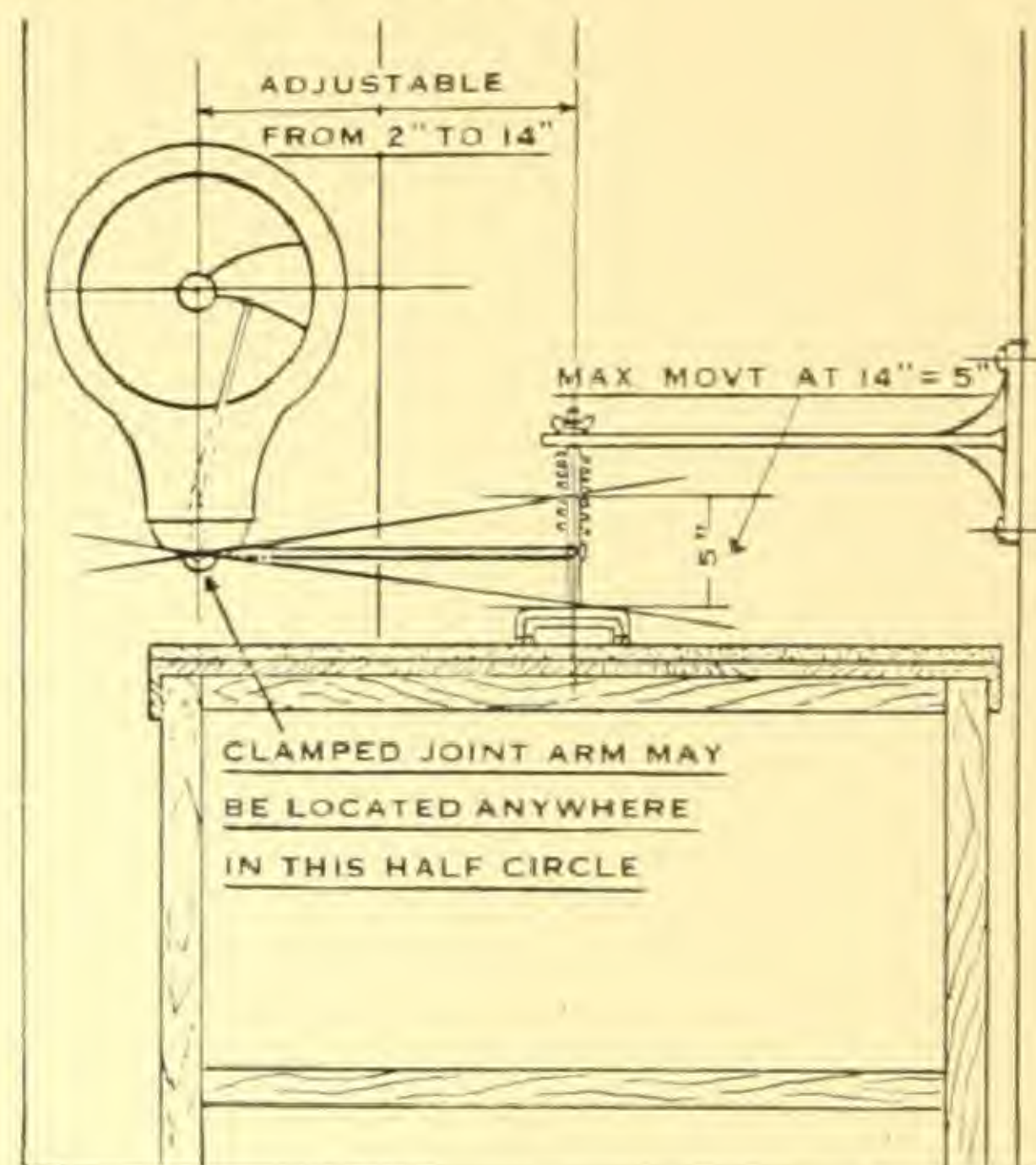
this record it is an easy matter to compare the relative operations of the several presses. It is also a check on the efficiency of men and equipment.



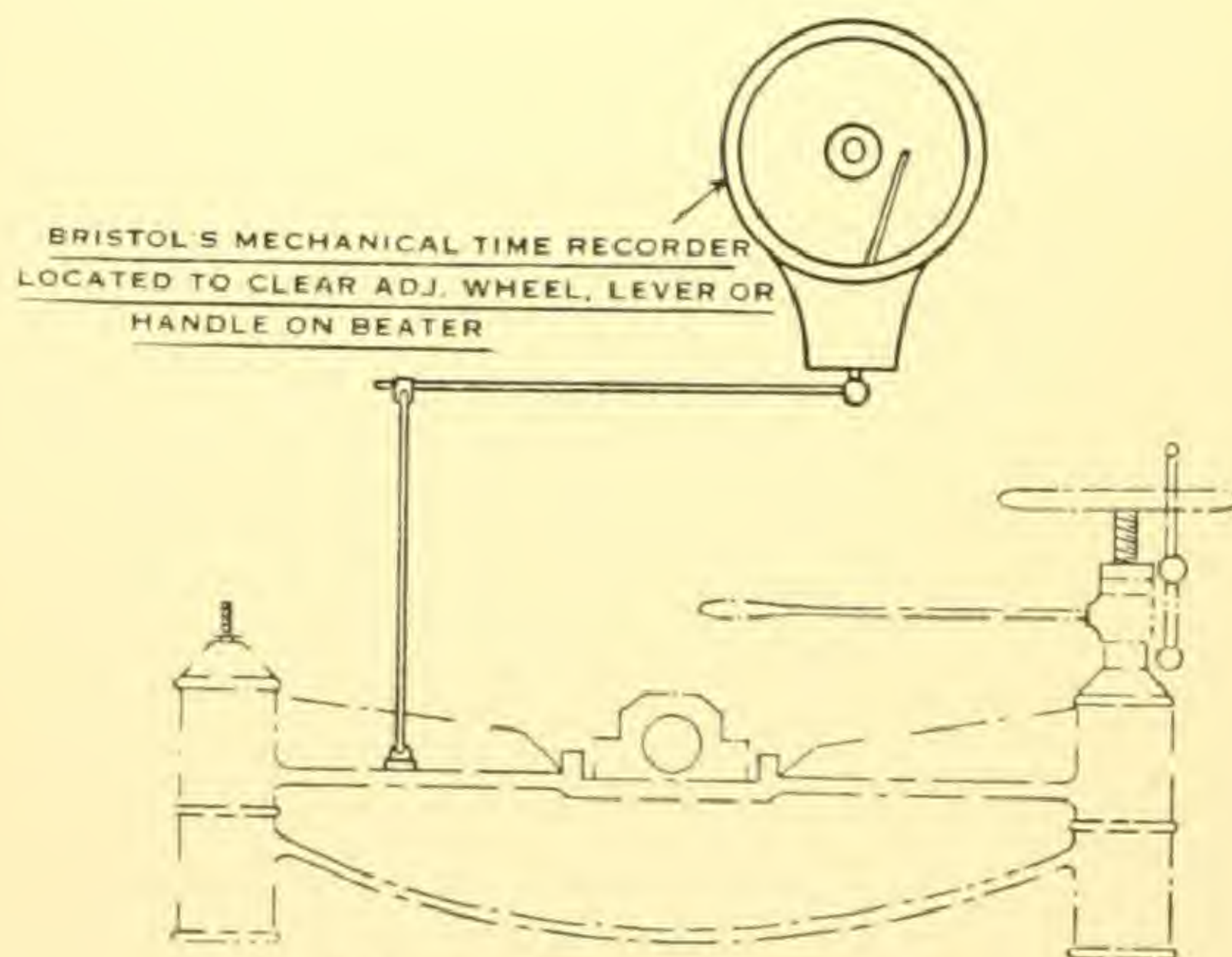
## A Few Methods of Applying Mechanical Motion Recorders



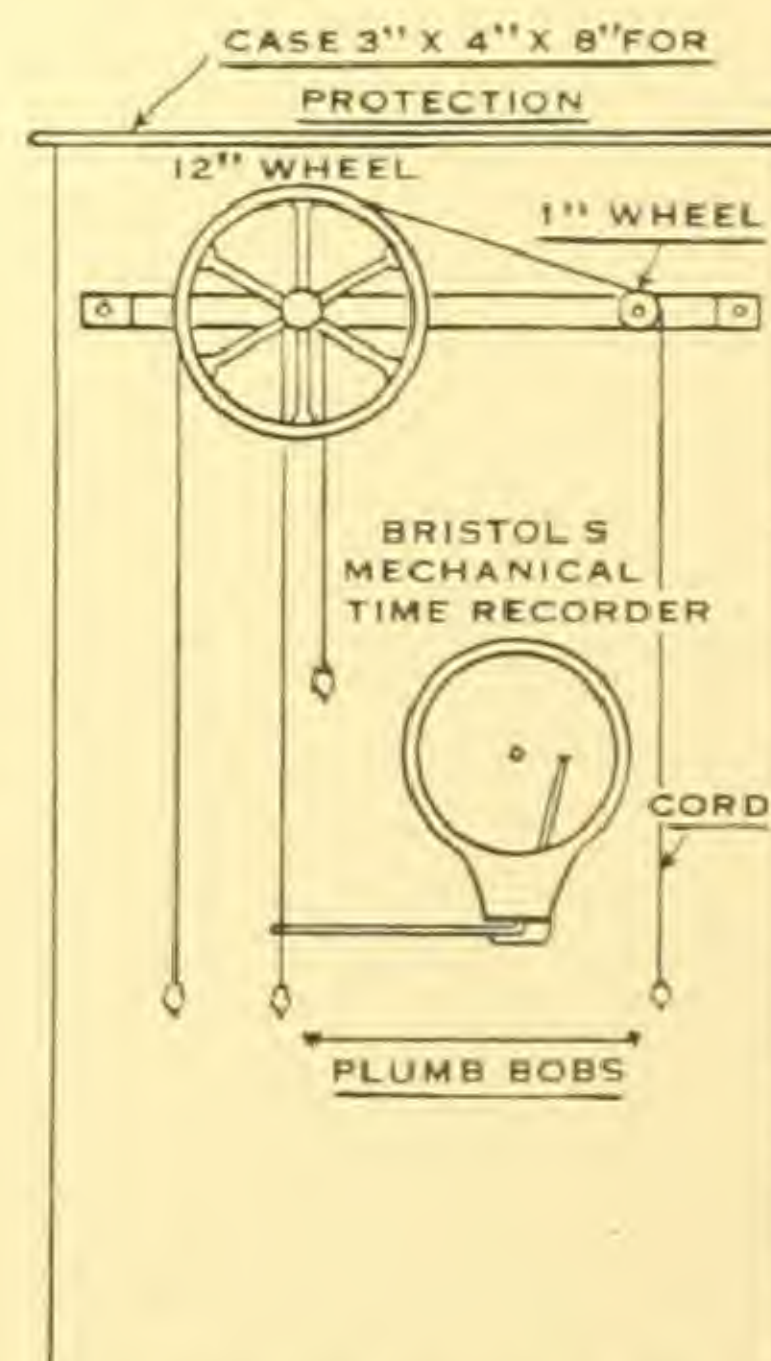
Mechanical Motion Recorder used as a Liquid Level Gauge



Applied to Paper Rolling Machine to Record thickness of paper



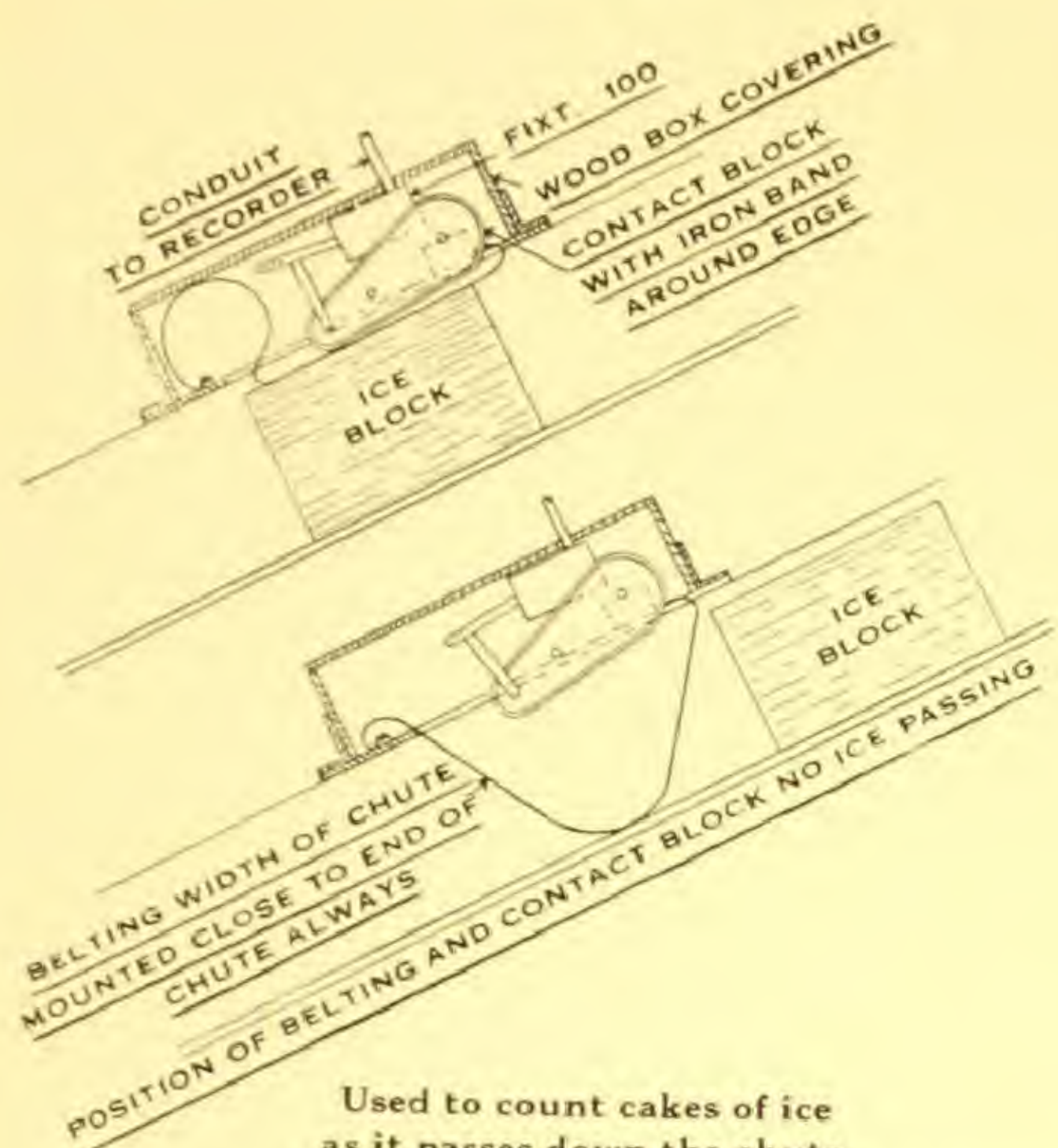
Used in connection with Lighter Bar of Pulp Beater



To record operation of Gas Holder

Operation  
Recorder  
connecti  
other rec  
instrume  
alarm be  
The Oper  
Recorder  
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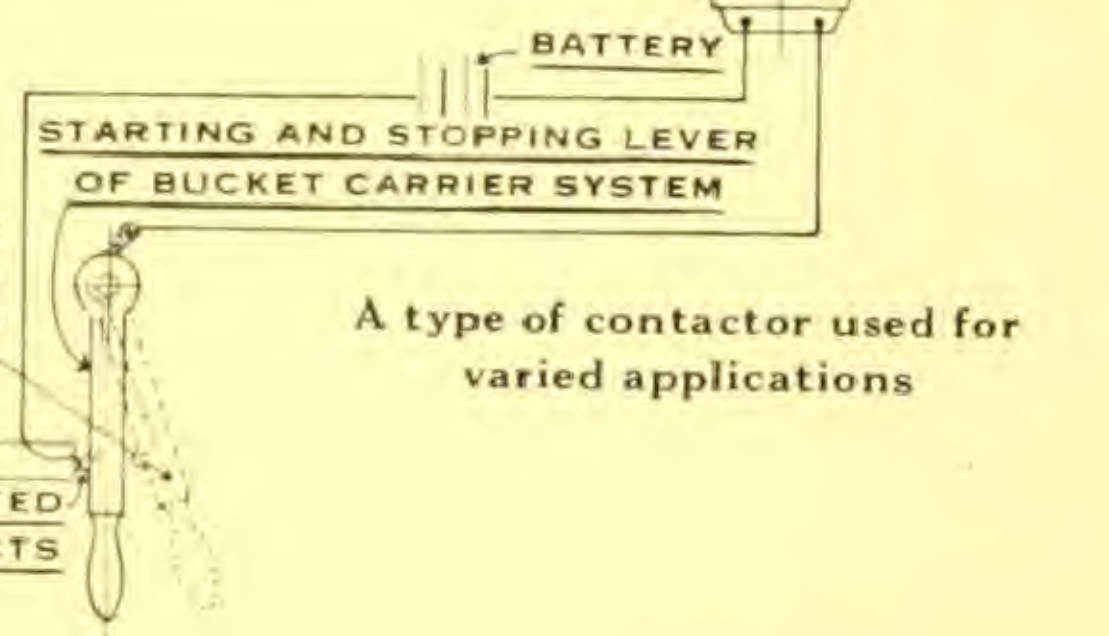




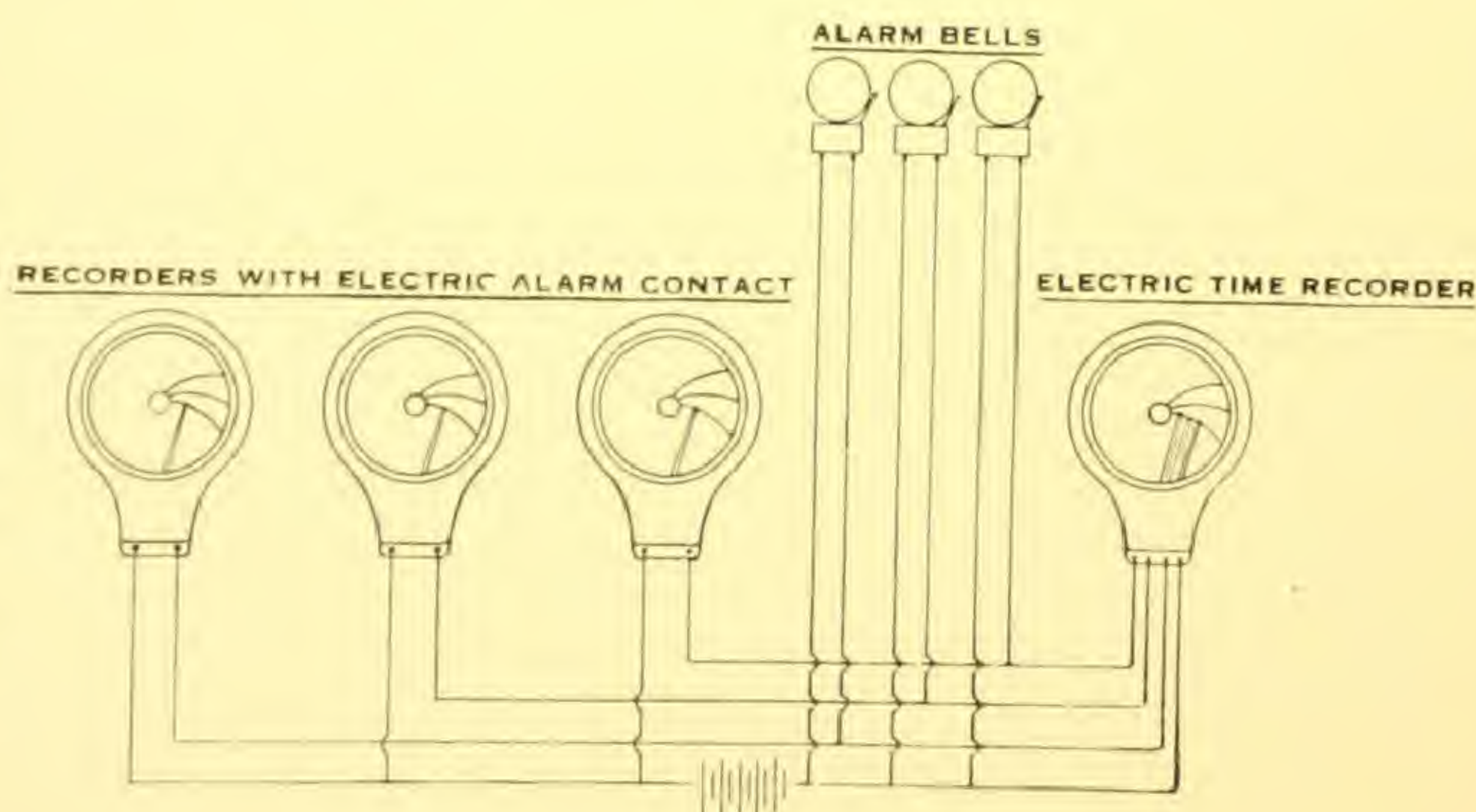
Used to count cakes of ice as it passes down the chute

ANY POSITION OF STARTING LEVER WHEN SYSTEM IS IN USE SHOWING CIRCUIT OPEN

POSITION OF STARTING LEVER WHEN CARRIER SYSTEM IS NOT IN USE. SHOWING CLOSED CIRCUIT



A type of contactor used for varied applications



Operation Recorder used in connection with other recording instruments and alarm bells.

The Operation Recorder records each time the alarm is rung.

## How Electric Operation Recorders Are Used For Some Applications



## Charts

Below is given list of charts with ranges etc., to select from for your particular use.

Samples of charts will be sent for inspection. When requesting samples, specify the chart number.

### For—MECHANICAL MOTION RECORDERS

ROUND CHARTS for use with  
 Mechanical Motion Recorders Models 911 and 940.

No.	Scale	Graduation	One Rev. of Chart	Size
952	0-20	Uniform	12 Hour	12"
964	0-40 ft.	Uniform	24 Hour	12"
967	0-50 ft.	Uniform	24 Hour	12"
965	0-100	Uniform	24 Hour	12"
953	0-1 1	Uniform	7 Day	8"
961	0-1 1	Uniform	24 Hour	8"
960	0-100	Uniform	24 Hour	8"
962	0-20"	Uniform	24 Hour	8"
968	0-50"	Uniform	24 Hour	8"
971	5-0-10"	Uniform	7 Day	8"

STRIP CHART for use with  
 Mechanical Motion Recorder Model 925.

No. S-2051 Scale 0-20" Uniform Graduation Speed 3" per Hour.

### For—ELECTRICAL OPERATION RECORDERS

ROUND CHARTS for use with  
 Electrical Operation Recorders Models 911 and 940.

Chart No.	Radial Time Divisions	One Rev. of Chart	Size	Chart No.	Radial Time Divisions	One Rev. of Chart	Size
910	10 Seconds	1 Hour	12"	909	12 Seconds	1 Hour	8"
908	12 Seconds	1 Hour	12"	914	2 Minute	12 Hour	8"
915	1 Minute	8 Hour	12"	906	5 Minute	24 Hour	8"
912	1 Minute	6 Hour	12"	902	10 Minute	24 Hour	8"
905	2 Minute	12 Hour	12"	901	15 Minute	12 Hour	8"
917	5 Minute	8 Hour	12"	907	1 Hour	7 Day	8"
913	10 Minute	24 Hour	12"				
904	15 Minute	12 Hour	12"				
911	1 Hour	7 Day	12"				

STRIP CHART for use with  
 Electrical Operation Recorder Model 925.

No. S901—Speed of Chart 1 Inch per Hour.  
 S900—Speed of Chart 3 Inches per Hour.  
 S902—Speed of Chart 6 Inches per Hour.

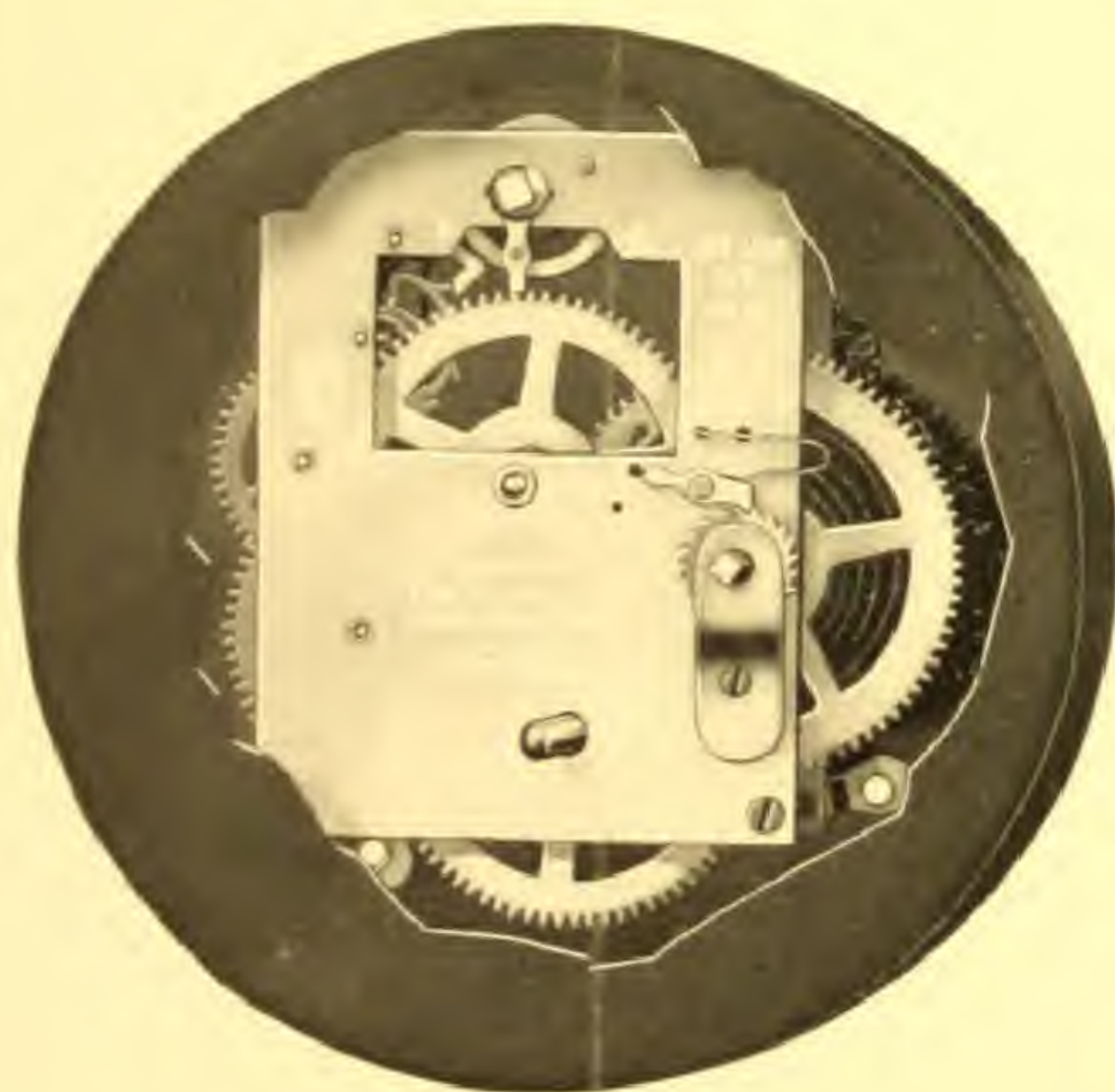


## Clock Movement

### USED IN BRISTOL'S RECORDERS

Located back of the chart in all Bristol's Recording Instruments is a clock movement, the purpose of which is to revolve the chart. This is an important function because it makes it possible to furnish the information on the chart as to the exact time at which operations take place.

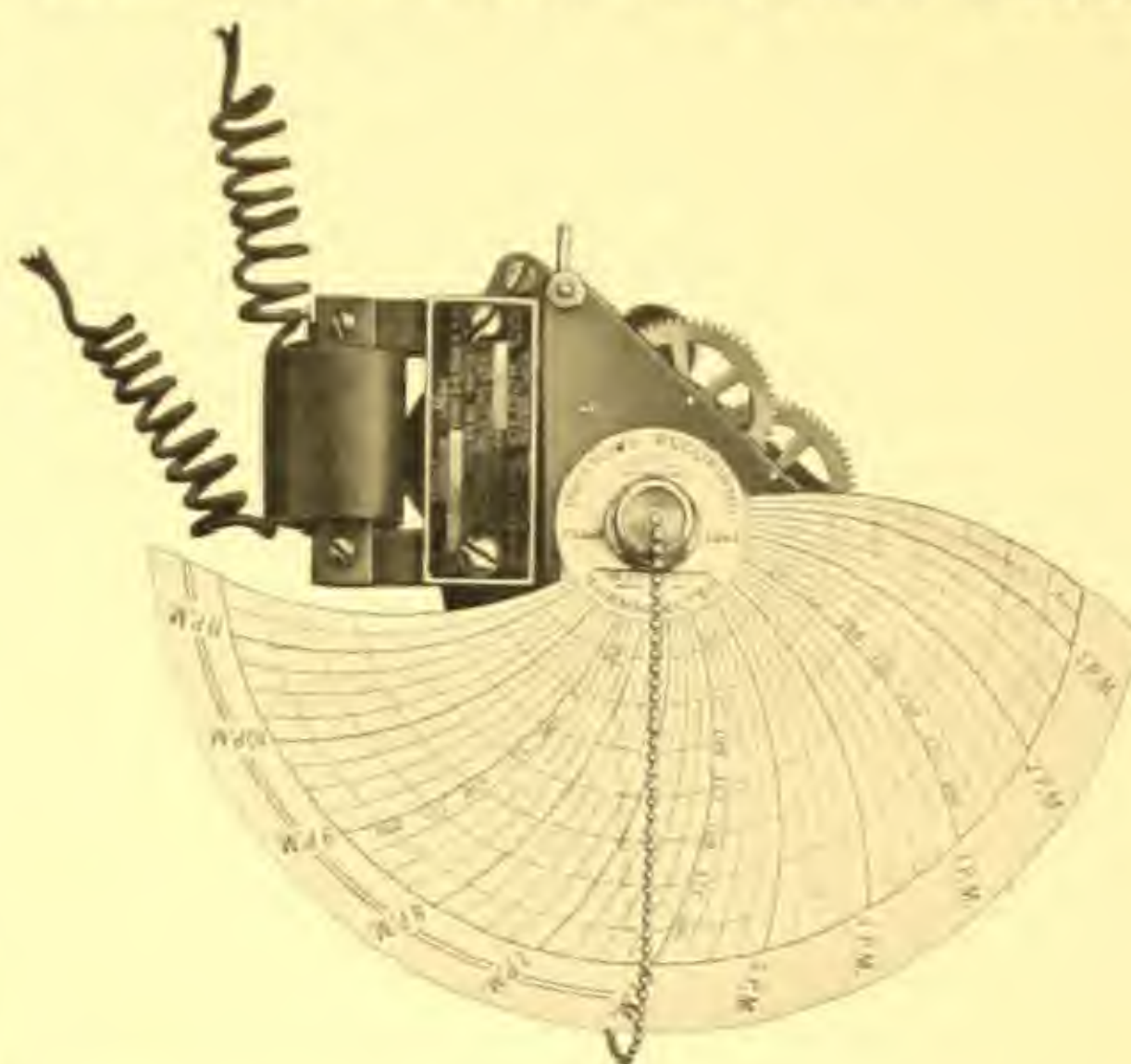
#### SPRING MOTOR CLOCK



The standard clock used in Bristol's Round Chart Recorders is a Seth Thomas movement, spring motor type. This high-grade movement can be depended upon to operate continuously, and insures a minimum of clock trouble.

Shown in illustration it is mounted in an individual metal case which is furnished as an extra precaution to protect the clock from dust and mechanical injury.

#### ELECTRIC MOTOR OPERATED CLOCK



When desired, electrically operated clock can be furnished. It is used in place of a spring motor clock, and, of course, has the advantage of no winding required. For large installations where several recorders are used equipped with the electric clocks, it is possible to have all charts operating in unison.

The electric clock furnished with Bristol's Recorders is the "Warren Telechron Clock." It operates on alternating current where frequency is known to be constant, or where power system has synchronous frequency. It can be furnished to use for 60, 50, 40 or 25 cycles.

This electric clock is available for 24-hour or 7-day revolutions on round chart recorders, and for 1, 3, 6 or 12 inch per hour speeds on strip chart recorders.

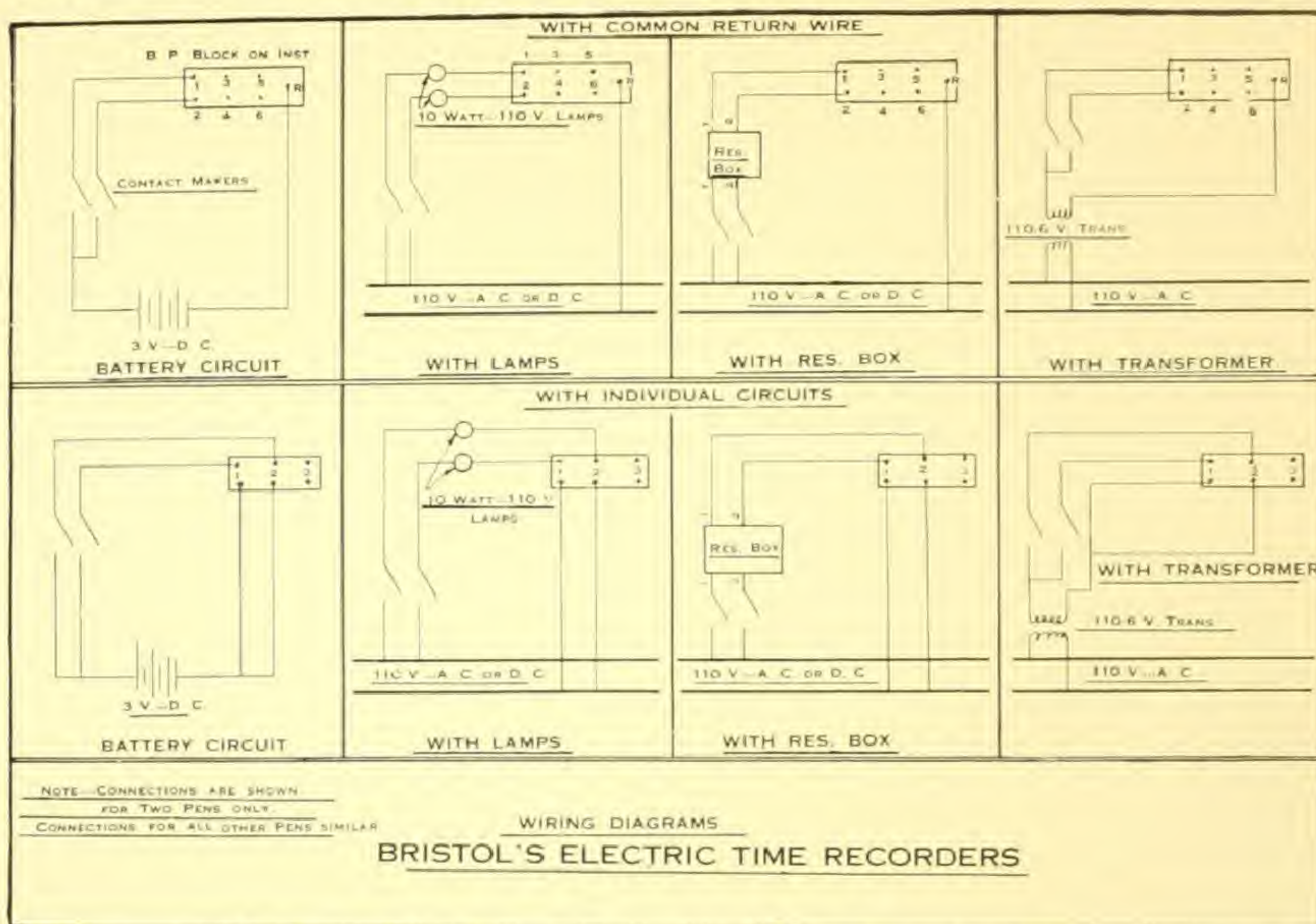
As the Electric Clock is not standard equipment an extra charge is necessary.



## Wiring Diagrams

### FOR ELECTRICAL OPERATION RECORDER

NOTE: Connections are shown for two pens only, but for any other number it is similar.



### ADDITIONAL RESISTANCE



When operated from direct current, Bristol's Electrical Operation Recorders can be furnished self-contained for a maximum of three volts, using dry cells or storage battery. For higher voltage, that is, lighting or power circuit of 110, 220 or higher, a Resistance Box like that shown is necessary. This is inserted in series to reduce the power applied to the magnet coil.



## DIRECTIONS FOR ORDERING

*For Use with Catalog No. 1601*

### BRISTOL'S MECHANICAL MOTION AND ELECTRICAL OPERATION RECORDERS

1. QUANTITY.
2. MODEL NUMBER. (911, 940 or 925.)
3. FINISH OF CASE. (If other than Standard.)
4. SIZE OF CHART. Round Charts can be furnished 12-Inches or 8-Inches in diameter. Strip Charts are always 6-Inches wide in rolls 90-Feet long.
5. CLOCK OR REVOLUTION OR CHART.  
Round Chart—7-Day, 24-Hours and 12-Hours as listed. Faster speeds can be furnished when desired.  
Strip Chart—Clock speeds of 1-Inch per hour, 3-Inches per hour and 6-Inches per hour are standard.
6. CHART NUMBER. Give chart number if listed. In case chart required is not listed give the details of what is wanted, and if possible a rough sketch. Special charts can be furnished graduated to order. Prices quoted on request.
7. CONNECTIONS. (Front or Back Connected.)  
Front Connection is standard for Model 911 Mechanical Motion Recorder, and will be furnished unless otherwise specified. On Models 940 and 925 Back Connection is standard and is the only way in which these models can be furnished.  
Front Connection is standard for all models of Electrical Operation Recorders and will be furnished unless otherwise specified.
8. NUMBER OF PENS. Electrical Operation Recorders.
9. VOLTAGE. Of current used to operate Instrument. (Does not apply to Mechanical Motion Recorder.)
10. FREQUENCY. If alternating current is used state frequency. (Does not apply to Mechanical Motion Recorders.)
11. APPLICATION FOR WHICH INSTRUMENT WILL BE USED. In order that there may be no possible chance to furnish the wrong equipment for the application in hand, in addition to the information given above it is desirable to know just what is required of the instrument and where it is to be used. Give as much of this information as possible, and rough pencil sketches are oftentimes helpful.
12. SHIPPING AND BILLING DATA.



## LIST PRICES

For Use with Catalog No. 1601

## ELECTRICAL OPERATION RECORDERS

## ROUND CHART MODELS

Prices given below include Instrument with Standard Finish Case, 24-hour or 12-hour clock, and furnished complete with 100 Charts, Bottle of Bristol's Special Recording Instrument Ink and Filler, Padlock and two Keys, Clock Key with Transformer or Resistance as required, Screws or Bolts for Mounting.

## 3 VOLTS D. C. OR 6 VOLTS A. C. 30 OHM COIL

Model No.	No. Pens	Size Chart		For Additional Pens
911	1	12-Inch	\$55.00 List	Add \$11.00 List each up to 12
	1	8-Inch	45.00 "	" 11.00 " " " " 6
940	1	12-Inch	60.00 "	" 11.00 " " " " 12
	1	8-Inch	50.00 "	" 11.00 " " " " 6

## 440-220 OR 110 VOLTS A. C. WITH TRANSFORMER 6 V. SEC.

911	1	12-Inch	\$65.00 List	Add \$11.00 List each up to 12
	1	8-Inch	55.00 "	" 11.00 " " " " 6
940	1	12-Inch	70.00 "	" 11.00 " " " " 12
	1	8-Inch	60.00 "	" 11.00 " " " " 6

## 110 VOLTS D. C. WITH RESISTANCE 10 OHMS PER VOLT

911	1	12-Inch	\$68.00 List	Add \$13.00 List each up to 12
	1	8-Inch	58.00 "	" 13.00 " " " " 6
940	1	12-Inch	73.00 "	" 13.00 " " " " 12
	1	8-Inch	63.00 "	" 13.00 " " " " 6

## 220 VOLTS D. C. WITH RESISTANCE 10 OHMS PER VOLT

911	1	12-Inch	\$70.00 List	Add \$15.00 List each up to 12
	1	8-Inch	60.00 "	" 15.00 " " " " 6
940	1	12-Inch	75.00 "	" 15.00 " " " " 12
	1	8-Inch	65.00 "	" 15.00 " " " " 6

7-Day Clocks ..... \$4.00 Extra List

Electric Time Recorder Pen can be applied to Round or Strip Chart Recording Gauges or Thermometers for checking time of operations	110V D. C. or A. C. ....	\$35.00
	220 V D. C. Extra .....	2.50
	Battery or Dry Cells .....	25.00

Resistance can be mounted inside of Instrument on 110 Volts on one or two pens if desired. No extra charge.  
 For D. C. Instruments for voltage over 220 ..... Quoted on Request  
 Pen Shifter to permit making 7 records on one Chart on single pen recorder ..... Quoted on Request

For direct current over 220 Volts, ..... Prices Quoted on Application  
 When required with individual circuit to each magnet, add ..... \$10.00 Extra List  
 Double Throw for marking penarm on request, ..... No Extra Charge



September, 1927

## LIST PRICES

*For Use with Catalog No. 1601*

### ELECTRICAL OPERATION RECORDERS

#### STRIP CHART MODELS

Prices given below include Instrument with Standard Finish Case, and furnished with one 90-Foot Chart Roll, Bottle of Bristol's Special Recording Instrument Ink and Filler, Padlock and two Keys, also Transformer or Resistance as required, Screws or Bolts for Mounting.

#### 3 VOLTS D. C. OR 6 VOLTS A. C. 30 OHM COIL

Model No.	No. Pens	Size Chart	For Additional Pens	
925	5	Strip	\$250.00 List	Add \$25.00 List for every five pens up to 20

#### 440-220 OR 110 VOLTS A. C. WITH TRANSFORMER 6 V. SEC.

925	5	Strip	\$260.00 List	Add \$25.00 List for every five pens up to 20
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#### 110 VOLTS D. C. WITH RESISTANCE 10 OHMS PER VOLT

925	5	Strip	\$265.00	Add \$40.00 List for every five pens up to 20
-----	---	-------	----------	-----------------------------------------------

#### 220 VOLTS D. C. WITH RESISTANCE 10 OHMS PER VOLT

925	5	Strip	\$275.00 List	Add \$50.00 List for every five pens up to 20
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For direct current over 220 Volts..... Prices Quoted on Application  
 When required with individual circuit to each magnet..... add \$10.00 Extra List  
 Double Throw for marking penarm on request..... No Extra Charge

### CONTACTORS

Lever Type .....	\$ 5.00
Heavy Duty Type "E" .....	28.00
Push Switch Type "A" .....	7.50
Roller Type "H" .....	15.00

### FOR TELEPHONE AND TELEGRAPH SERVICE

500 Ohm Coils for 24 Volt D. C. used on telephone and telegraph no extra charge, over 110 Volts D. C. prices

### RESISTANCE

D. C. Resistance, Ward Leonard Type, on porcelain base for 250 Volts D. C. or less.....each \$3.50  
 Prices for 110 Volt D. C. cover same voltage for A. C., if A. C. instrument wanted with resistance.



## LIST PRICES

*For Use with Catalog No. 1601*

### MECHANICAL MOTION RECORDERS

#### ROUND CHART MODELS

Prices given below include Instrument with Standard Finish Case, 24-hour or 12-hour clock, and furnished complete with 100 Charts, Bottle of Bristol's Special Recording Instrument Ink and Filler, Padlock and two Keys, Clock Key and Screws or Bolts for Mounting.

	Model	12-Inch Chart	8-Inch Chart
	911	\$40.00 List	\$30.00 List
	940	50.00 "	40.00 "
7-Day Clocks.....			\$4.00 Extra
Instruments are regularly furnished front connected. When required back connected for Model 11, there is a charge of.....			\$5.00 Extra List
Case can be furnished made of bronze (Model 910) with nickel finish, at.....			\$5.00 Extra List

#### STRIP CHART MODELS

Prices given below include Instrument with Standard Finish Case, and furnished with one 90-Foot Chart Roll, Bottle of Bristol's Special Recording Instrument Ink and Filler, Padlock and two Keys, Clock Key and Screws or Bolts for Mounting.

	Model	Strip Chart
	925	\$155.00 List

### WARREN TELECHRON CLOCKS

For Round Chart Recorder, Direct Marking, 24 Hour, Extra List.....	\$25.00
Other Speeds quoted on request.	
For Strip Recorders, Standard Speeds without rewind, Extra List.....	10.00

### SUPPLIES

#### ROUND CHARTS

Ink Recording, for use with Bristol's Recording Motion and Electrical Operation Recorders, size 8-Inch Diameter, per 100 .....	\$ .80
Size 12" Diameter.....	1.65

#### STRIP CHARTS

For use with Bristol's Recording Motion and Electrical Operation Recorders, per Roll 90-Feet Long	1.10
---------------------------------------------------------------------------------------------------	------

#### CHARTS ENGRAVED TO ORDER, quoted on request.

#### BRISTOL'S SPECIAL RECORDING INSTRUMENT INK

Four-ounce Bottle.....	.65
Pint Bottle.....	1.90
Quart Bottle.....	3.30
Combination Rubber Stopper and Glass Filler.....	.10

#### CHART HOLDER FOR WALL OR SHELF USE

Universal Style.....	1.50
----------------------	------

ALL THE ABOVE PRICES ARE F. O. B. WATERBURY, CONNECTICUT

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## Transformer



When Bristol's Electrical Operation Recorders are used in connection with Alternating Current of commercial voltages, a Transformer is furnished with each instrument in order to reduce the voltage applied to the proper value. For ordinary use this is six volts, but can be furnished with secondary winding for higher voltage when required to overcome high resistance due to long wiring connection. This is available for use on 110, 220, 440 or 550 volts A. C.

## Contactors

### BRISTOL'S IMPROVED LEVER OPERATED CONTACTOR



This Contactor is suitable for use on A. C. or D. C. circuits up to 220 volts. The working parts are entirely inclosed except for the slot through which the lever operates.

Only a small amount of power is required to operate this contactor. The make and break is accomplished by a wiping action; contact points are silver.

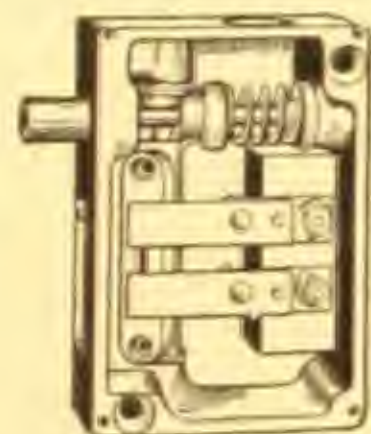
### CONTACTOR TYPE "E"

For Heavy Duty Service



This contactor is especially suitable for operations like reversing valves on Open Hearth Furnaces and other heavy duty work. It is substantially built.

### TYPE "A" PUSH SWITCH



For installations where it is required to use a Push Button to close the circuit, such as on doors, this style of contactor is adapted. In operation, the circuit is closed when button is pushed in, and opened when released.

### CONTACTOR TYPE "H"



Sometimes a contactor with roller is required to adapt it to the device with which it is to be used, for which purpose the above illustrated contactor is recommended.





*Cakes of ice as they are drawn from the tanks in this artificial ice plant are automatically counted and recorded on the Bristol's 3-Pen Electric Operation Recorder*



*In the paper mill many Bristol's Mechanical Motion Recorders are used in connection with pulp beaters*



*Mounted on the panel board in a big Southern steel plant two Electric Operation Recorders having 4-pens each, record the operation of valve reversal on gas entering by product oven*



*Installed in the office of the general manager in a big Western Cement Plant, this 20-Pen Electric Operation Recorder tells him at all times if the various crushers, rolls, etc. are in operation*



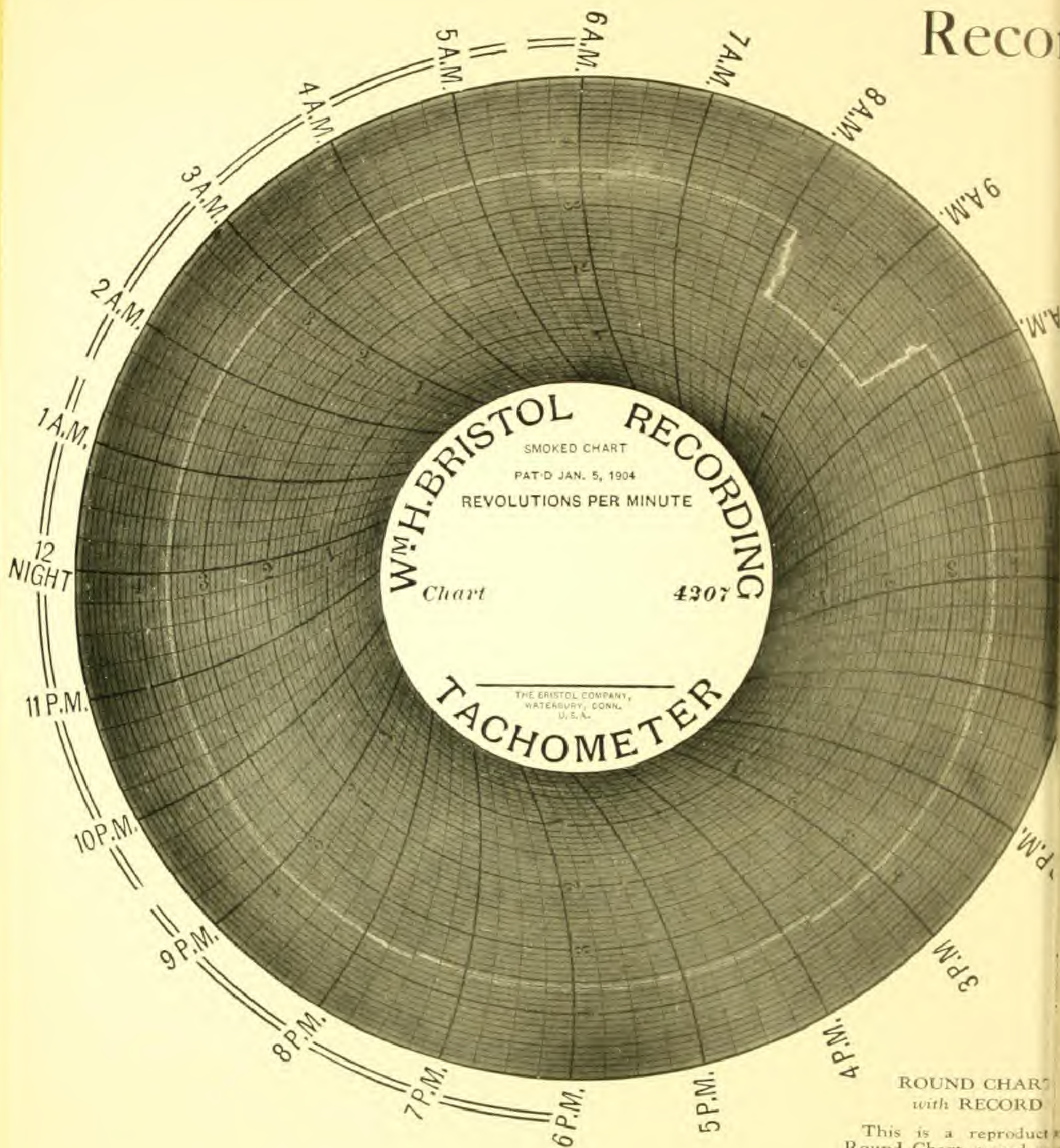


# BRISTOL'S TACHOMETERS *for* *Recording and Indicating*

*for the speed of rotation  
of any piece of revolving  
machinery. Some of these are:  
Turbine and Generator in the  
Power Plants, Blowing Engine  
in Blast Furnace Plant,  
Paper Machine in  
Paper Mill,  
Hoisting Eng-  
ine in Mines,  
etc., etc.*







Record Sp  
on

ROUND CHART  
with RECORD

This is a reproduction of a Round Chart record made by Bristol's Recording Tachometer, Model 83, installed in connection with a paper machine at Wausau Paper Fibre Company, Wausau, Wisconsin.

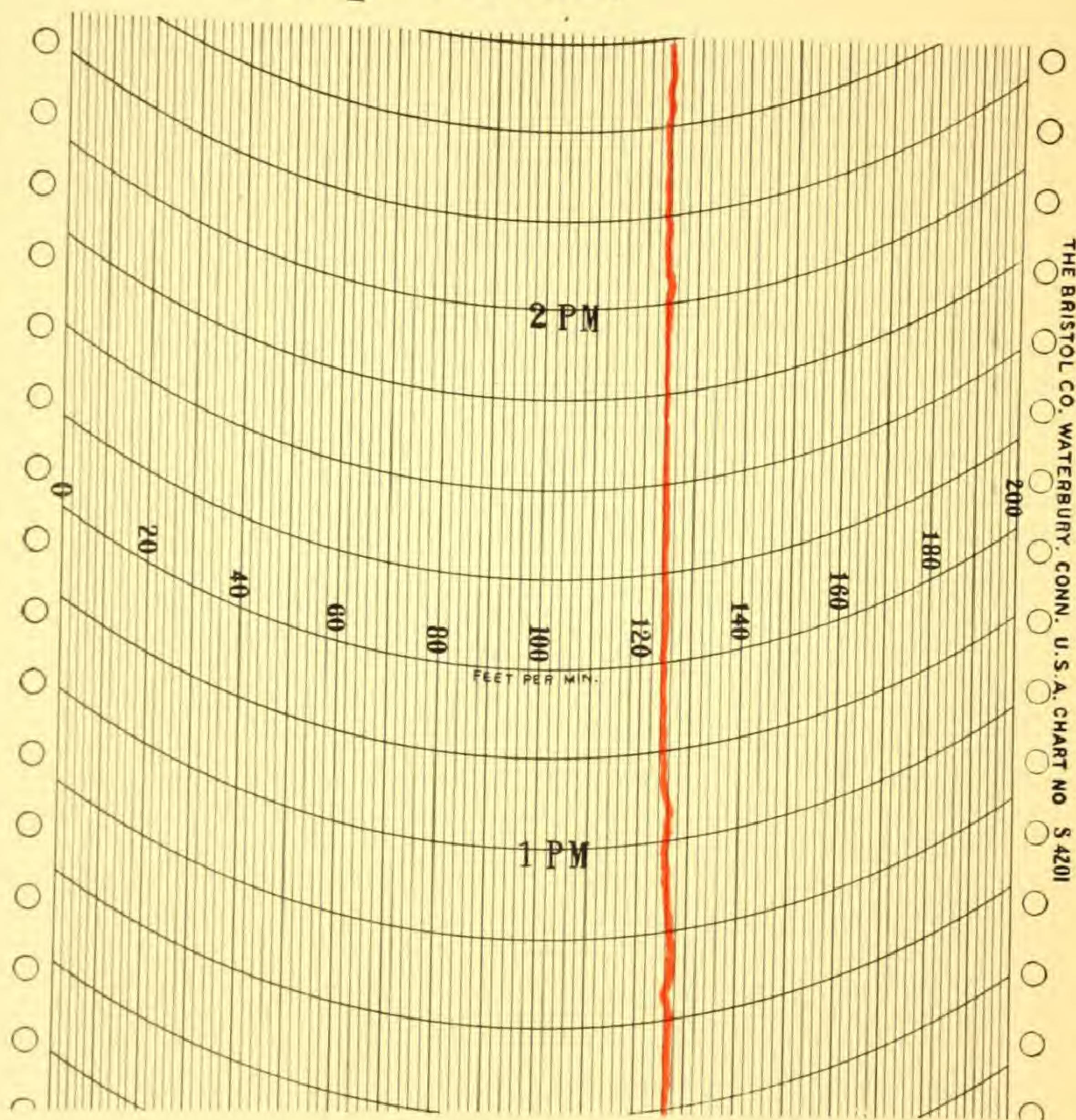


# Speed on Round Chart or Strip Chart

is simply a matter of  
whether the Round  
or Strip Chart is  
suitable for individual  
The instrument used  
producing either form  
of record is equally de-  
pendable.

The Round Chart pro-  
vides a record for a com-  
plete cycle of time, i. e.,  
24 hours, 12 hours, etc., in  
a very restricted amount  
of space, thus it requires  
a quick glance to take  
the entire situation and  
immediately detect any  
variations in operating  
conditions.

In contrast, the Strip  
Chart gives a continuous  
record over several weeks.  
The record may be preserved  
entire or cut off to in-  
clude any period of time  
desired. Within the limits  
of the instrument case the  
record is visible for 8 hours,  
or operated at standard  
rate of 1-inch per minute,  
or a longer time if not  
desired, but instead,  
the record is passed through  
the bottom of case.



**SPECIMEN STRIP CHART**  
with RECORD

This shows section of Strip Chart with  
record made by Bristol's Recording Electric  
Tachometer, Model 1825. The instrument is  
installed in connection with paper machine  
and shows speed of paper passing over roll.



## ELECTRIC TACHOMETER

The Bristol's Electric Tachometer described in this bulletin is an electrical device for recording and indicating the speed of rotation of any piece of revolving machinery. The equipment includes (1st) a Magneto, (2nd) Instrument which is a Voltmeter.

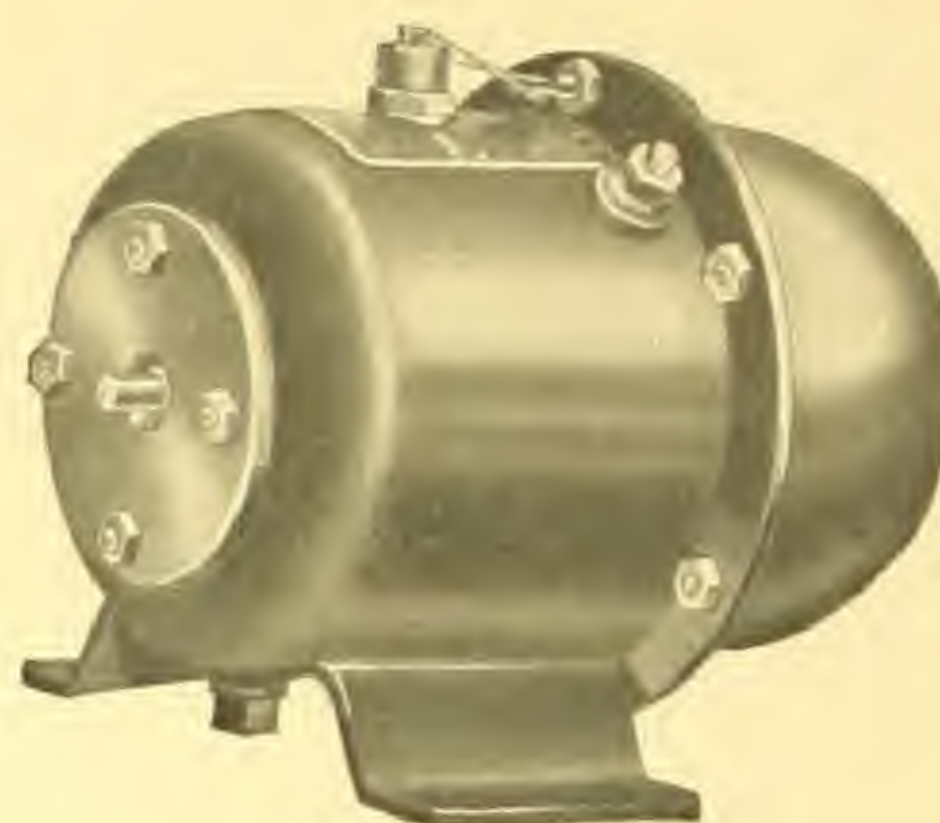
### HOW IT OPERATES

The magneto is driven from the machine whose speed is to be measured and, generates a voltage directly proportional to its speed. A wire lead connects the magneto to the Voltmeter Instrument which is calibrated to read in revolutions per minute, feet per minute, etc.

### ADVANTAGES

The Electric Type of Tachometer has many advantages to recommend it.

1. Inherently more accurate than some other types.
2. Accuracy is practically permanent and does not change with use, because wear on the bearings of the magneto has no effect on the voltage generated.
3. Follows variations in speed gradually without jumping.
4. No complicated moving parts.
5. Very light in weight.
6. Occupies little space and may be readily installed on machines and devices where a more bulky and complicated apparatus would be impossible.
7. The Recording and Indicating Instruments may be placed in any position even remote from the magneto by simply extending the connecting wire leads.
8. When properly installed and adjusted, the life of this electric tachometer equipment is exceptionally long.
9. Very little lubrication or attention of any kind is required.



## MAGNETO

The magneto used as part of Bristol's Tachometer Equipment is the "Weston" Model 44. It is a direct current generator having a permanent magnet field and revolving armature provided with a commutator.

The distribution and uniformity of the magnetic flux across the air-gap is governed by pole pieces of proper shape and the permanency of the magnetic circuit in the magneto is obtained by an exceptionally small air-gap.

The brushes and commutator segments are constructed of a special non-corrosive alloy having an exceptionally long life, and there is no change in terminal voltage due to variations in the contact resistance between these two parts. The brushes are definitely adjusted for position when the magneto is assembled. These and the commutator do not require any attention except cleaning at long intervals. However, the brushes are so designed that they may be easily replaced.

The armature is constructed so as to have unusual mechanical strength and is mounted in self-aligning ball bearings which permit extremely free rotation and which require very little attention. These are the only moving parts in the magneto.

The instrument is mounted. As the polarity of the direction of the (+) the outside of the direction of the

A case is used to be thorough and also fields. For

### OPER

The of 6 volts resistance

The directly speed-volt





Exploded View Showing Parts of Magneto

The leads from the indicating and recording instrument are connected to two binding posts mounted on the periphery of the magneto case. As the magneto may run in either direction the polarity of the binding posts depends on the direction of rotation, and in order to indicate the (+) binding post, two arrows are shown on the outside of the case pointing in the two directions of rotation. The arrow which points in the direction agreeing with the actual rotation indicates the (+) binding post.

A case of drawn steel finished in black Japan is used to enclose all parts of the magneto. It thoroughly protects them from dirt and moisture, and also shields them against external magnetic fields. For dimensions see Drawing.

### OPERATING CHARACTERISTICS

The magneto is adjusted to generate an E.M.F. of 6 volts per 1000 R.P.M. and to have an internal resistance of exactly 100 ohms.

The voltage generated by the magneto is directly proportional to the speed, that is, the speed-voltage curve is a perfectly straight line.

### MAGNETO SPEEDS

200 R.P.M. is the lowest magneto speed for the highest reading on instrument when one recorder or indicator is used.

400 R.P.M. is the lowest magneto speed for the highest reading on instrument when two recorders or two indicators or a recorder and an indicator are used.

1000 R.P.M. is the highest magneto speed for the highest reading on instrument or instruments.



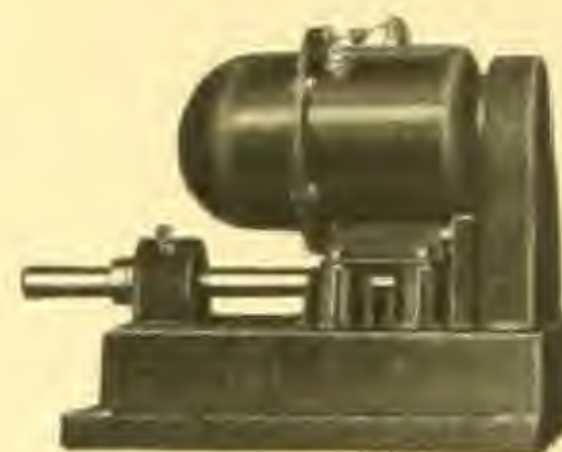
Magneto Mounted in Water-Tight Case



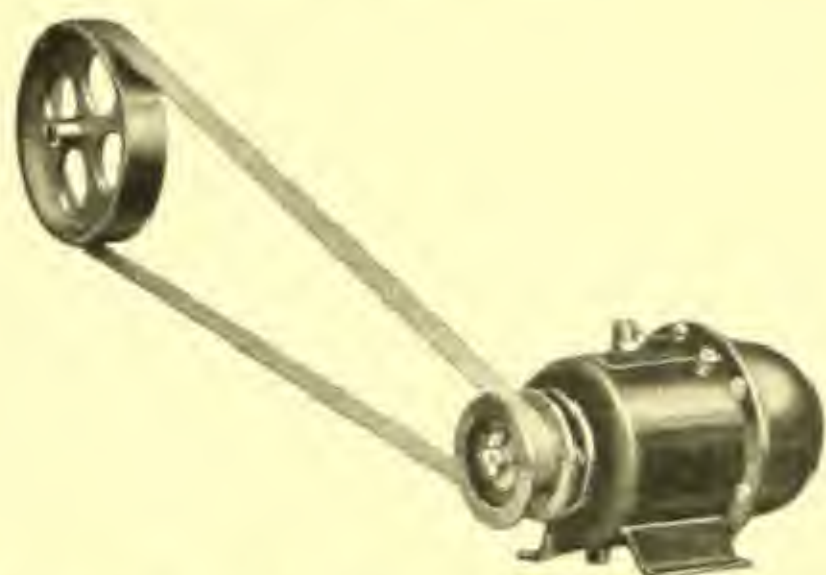
## METHODS OF DRIVE

The auxiliary driving mechanism for external connection, except for universal joint drive, is carried on a large dirt-proof ball bearing mounted on outside of the case and connected to the armature shaft through a flexible coupling so that no shocks or strains are transmitted to the armature shaft from the device of which speed is being measured.

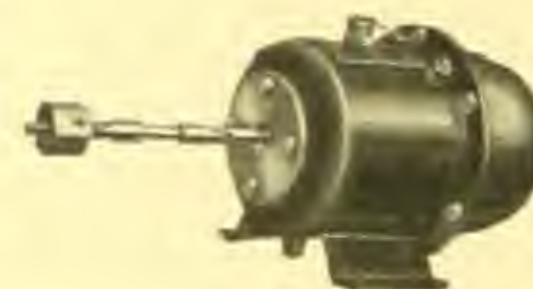
The illustrations following clearly illustrate the various methods of drives.



Magneto with speeding-up-stand



Magneto with pulley for belt drive



Magneto with universal joint for direct drive



Magneto on speeding-up-stand and with universal joint drive



Magneto with direct gear drive



Magneto with silent chain drive



Magneto on speeding-up-stand arranged for gear drive





Magneto with speed-reducing-stand arranged for belt drive



Magneto with speed-reducing-stand arranged for universal-joint drive



Magneto on speeding-up-stand arranged for silent chain drive



Magneto in Water-Proof Box with anemometer vane, for measuring variations in velocity of air currents

## SPECIAL UNIVERSAL JOINT

(For Use with Speeding-Up-Stand)



This is an extra heavy duty universal joint especially adapted for connecting counter shaft or speeding-up-stand to driving shaft. It is made by a concern specializing in high

grade machine work and is designed for heavier work than the standard universal joint included in specifications with regular tachometer equipment not employing speeding-up-stand.



## DIMENSIONS OF MAGNETOS

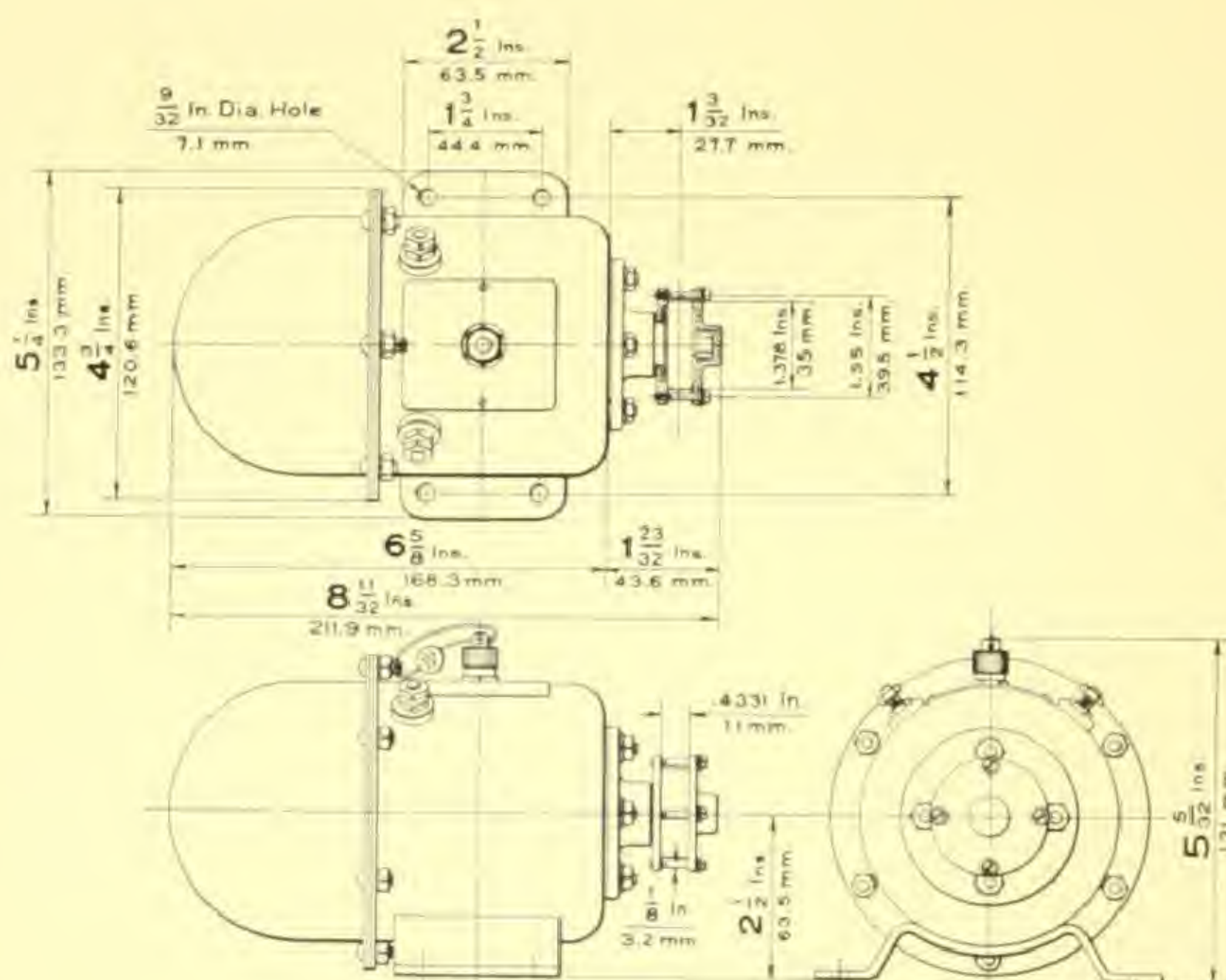


Diagram giving dimensions for  
standard Magneto Model 44.

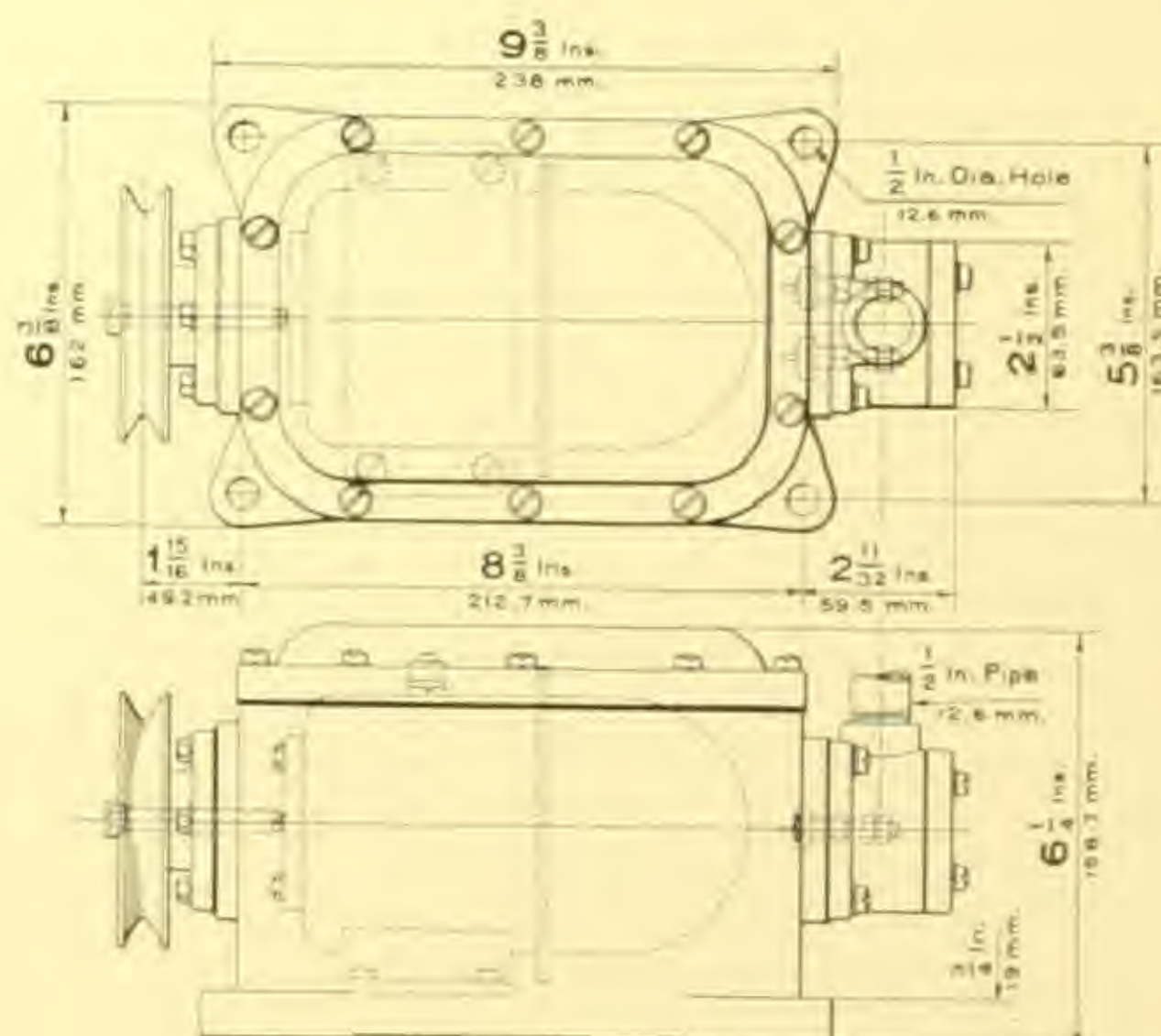


Diagram giving dimensions for  
Magneto Model 44 with Water-  
Tight Case.



## ELECTRIC TACHOMETER INSTRUMENT

All Bristol's Electric Tachometer Instruments use for measuring element a D.C. Voltmeter Movement, "Weston" make, which is specially designed for use in connection with magnetos and, is thus particularly adapted for tachometer work. It is double-pivoted high resistance type, and responds instantly to the slightest changes in voltage, also rugged and will stand up under long continuous service.

### LONG DISTANCE FEATURE

There is practically no limit to the distance possible between instrument and magneto; a duplex copper lead is used to connect these two units. For convenience, 15-feet is specified as standard length, but this is only arbitrary and can be varied to suit individual installations. The flexibility of this long distance feature makes it possible to use Bristol's Electric Tachometers in inaccessible and difficult locations where other types could not possibly be installed. It allows the instrument to be mounted in the most convenient place to be easily referred to.

### RANGE

Bristol's Electric Tachometer Instruments can be furnished to indicate or record any speed or revolution within usual commercial range limits. Each instrument is calibrated to range most suitable for individual needs.

## RECORDING INSTRUMENTS

Closer control and uniform operating conditions always follow wherever recording instruments are properly applied and used; because they furnish a reliable record hour by hour, day by day, of conditions as they take place. These records are available for inspection and readily show up any unusual occurrences; also an easy means of comparison, and with the information furnished it is often possible to trace the very source of any trouble. Bristol's Recording Tachometers for recording speed or revolution of all kinds of operating machinery are no exception to this rule.

### ROUND or STRIP CHART RECORDS

Bristol's Tachometers are furnished in two types: 1st, Instrument for making records on a Round Chart, 2nd, on straight or Strip Chart. Each has its advantages and should be selected with the idea as to which is better suited for the work in hand.



ROUND CHART  
RECORDING ELECTRIC  
TACHOMETER  
MODEL 1837

The round chart supplies a record for complete cycle of time, i. e., 24-hours, 12-hours, etc. When presented in this form, it is possible to take in the entire situation at a glance.

### DIRECT MARKING RECORDING SYSTEM

Direct marking recording system on smoked (carbon coated) chart is used with the round chart Bristol's Recording Electric Tachometer. This method reduces friction to a minimum, and this is essential because of the extreme sensitivity of the milli-voltmeter movement.

The chart used has a sensitized carbon coated surface and in operation, as the penarm comes in contact with the coated surface, it leaves a white record line. On removing the chart from the instrument, it is dipped into a fixative solution which makes the record permanent.

In addition to being very responsive to the slightest changes, this method of recording is absolutely reliable, and a record is always sure to result if the instrument operates. There is no evaporating or clogging. Furthermore, the record on the coated chart is very clean cut and may be read with a high degree of accuracy. Full sized reproduction of smoked chart with record shown on page 2.



### CHARTS

All charts used with Bristol's Round Chart Recording Electric Tachometers have uniform graduations on the time arc. This gives a uniformly open reading over the entire range. For list of charts see pages 14 and 15.

may be 24-hours, 12-hours, 6-hours, etc., as required. The charts used are also divided into time arcs which correspond to the speed of the clock. Thus it is always possible to tell from the chart record the exact time at which certain conditions take place.

### CLOCK

To revolve the chart, a powerful high grade clock is used, and is located directly back of the chart. These clocks can be furnished for different speeds so that the complete revolution of the chart

### INSTRUMENT CASE

The Recording Electric Tachometer Model 1837 is made in one size, to use 8-inch round charts. The case is rectangular in shape, made of all metal and finished in black enamel with nickel raised parts.



### STRIP CHART RECORDING ELECTRIC TACHOMETER MODEL 1825

The instrument shown here is designed to furnish a record on a straight or Strip Chart. Where continuous records for longer time than 24-hours

are required, or when a wide open record is wanted for test purposes, this Strip Chart Recording Model should be used.



## CHART

The chart is 6 inches wide, with an actual scale of  $5\frac{1}{4}$  inches. They are furnished in lengths 90-feet long and, when driven at a standard speed of 1-inch per hour, will furnish an unbroken record for 45-days duration. If for experimental purposes or other reasons, a closer detailed reading is required, faster speeds of 3-inches and 6-inches per hour, also 1-inch, 3-inches and 6-inches per minute are provided for by making a very simple adjustment. Other speeds can be furnished as specially required for individual instances. The fact that scale graduations are uniform on the arc is a further aid to accuracy in reading record.

## DIRECT MARKING INK RECORDING SYSTEM

The Direct Marking Ink method of recording is used with this Strip Type Recording Electric Tachometer. As may be seen from illustration, the penarm is mounted in a position above the chart and is so adjusted that it swings clear and does not come in actual contact with the chart. Capillary attraction causes the ink to flow from the pen point and makes a continuous record.

## CLOCK

Specially constructed powerful clock is used to automatically wind the chart and drive the roll. This clock requires winding only once every week.

## MOTOR OPERATED CLOCK

When desired, an electrically operated clock can be furnished in place of the spring wound type. This, of course, has the advantage of requiring no winding. This electric clock requires for operating alternating current of constant known frequency, or where power system has synchronous frequency.

Such an electric clock can be furnished for use with either Strip Chart Instrument or Round Chart. On Strip Chart Recorder it is available for chart speeds of 1, 3, 6 or 12-inches per hour and for 24-hour revolution on Round Chart Instruments.

As the electric clock is not standard equipment an extra charge is necessary.

## INSTRUMENT CASE

The case is metal and glass so constructed that it is dust-proof. The finish is black enamel.



## MULTIPLE RECORD INSTRUMENT

In addition to the Single Record Strip Chart Model, an instrument can be furnished to make as many as six records simultaneously on the same chart.

This instrument in general is like the single record strip chart instrument. However, instead of direct marking recording system, it uses vibrating penarm and multi-colored ribbon similar to that used on typewriter.

One measuring element and one recording arm only are used. A motor driven selective switch is used to automatically make contact with each magneto circuit. This motor is of standard make and is operated from lighting circuit.



## DUPLEX RECORDING INSTRUMENT

This instrument has two complete recording systems mounted side by side, and instead of one chart scale using different colors to distinguish records, it has a duplex scale on the same chart. It can be furnished for Direct Marking Ink Recording System or vibrating penarm and colored ribbon.



## INDICATING INSTRUMENTS



Indicating Electric Tachometer, Model 18-410, Round Type, arranged for Front Connection only.



Indicating Electric Tachometer, Model 18-252, Round Type, arranged for Back Connection only.



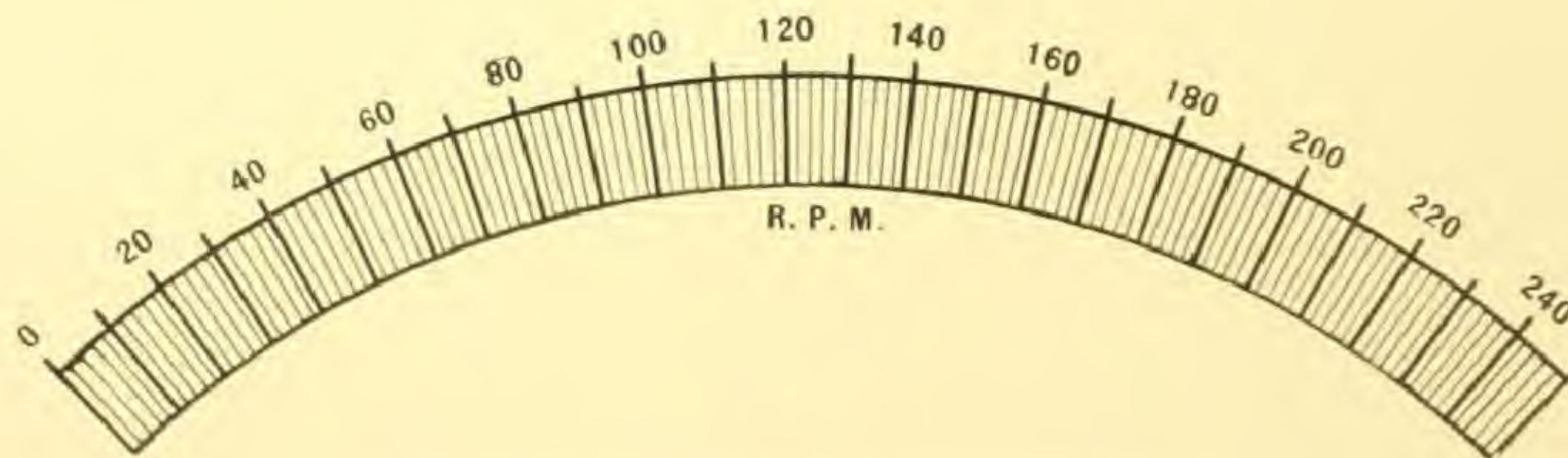
Indicating Electric Tachometer, Model 18-273, Fan Shaped Type, has extra wide scale. Arranged for Back Connection only. Model 18-422, similar except arranged for Front Connection only.

Sometimes Tachometers are wanted for use where the indicating type of instrument fills the requirements. For just such places there are several models of Bristol's Indicating Tachometers.

The usual method is to install indicating instrument near the machinery, the speed of which is being measured, and there used to keep the operator informed of conditions. But when wanted, two or even more indicating tachometers can be operated from the one magneto, and the instruments installed in widely separated parts of the

plant. Also indicating instrument can be furnished to use in combination with recorder.

Each Bristol's Indicating Tachometer is specially calibrated for range to suit individual application. Hand-drawn scales are used, which further makes the matter of range very flexible. If, however, indicator is to be used in combination with recording instrument, it should agree with the chart range of recorder. The scale divisions are uniform on the arc, and, thus provide a uniformly open reading over the entire range.



Sample scale as used with Indicating Electric Tachometer Models 18-252 and 18-410. Scale for use with Model 18-273 and 18-422 is considerably wider, being in actual measurement, seven and three-tenths inches.



## COMBINATION OF INDICATING AND RECORDING INSTRUMENTS

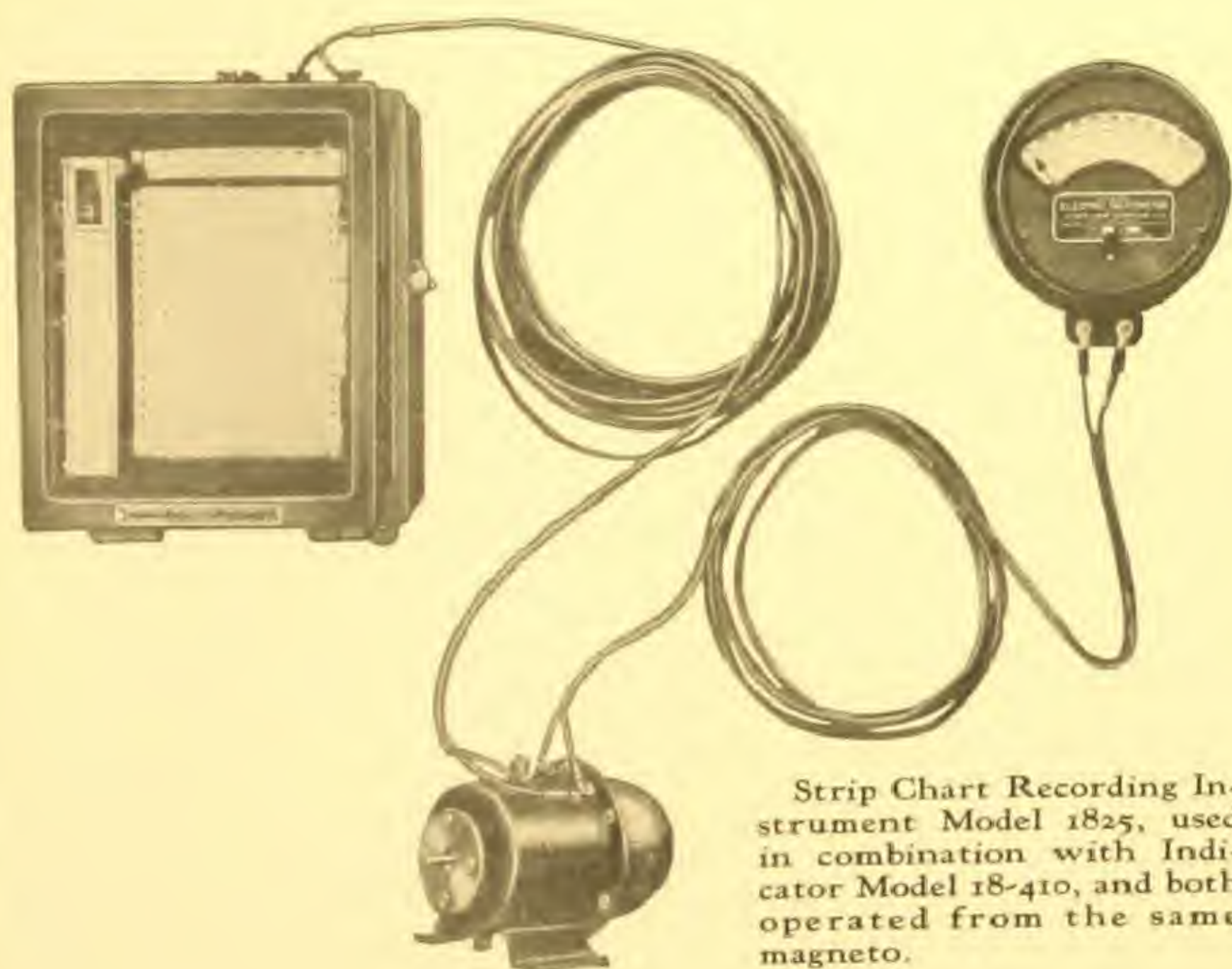
For indicating and recording at the same time the speed of revolution, a combination of indicating and recording instruments can be furnished to operate from the one magneto.

In using such an outfit, the indicating instrument is generally installed in the engine room for easy reference by the operating engineer, while the recorder is located in the supervising engineer's office, where he can tell at a glance just what the operating conditions are and have been.

The recording instrument also provides a permanent record for filing purposes and these are valuable for both engineering data and production studies.



Recording Electric Tachometer, Model 1837 and Indicating Model 18-410 operating from one magneto.



Strip Chart Recording Instrument Model 1825, used in combination with Indicator Model 18-410, and both operated from the same magneto.

Other combinations of instruments can be operated from the same magneto, it is only necessary that they be connected in parallel. Thus it may be two recording instruments; two indicating instruments; three indicating instruments; or one recording instrument and two indicating instruments. In fact, all sorts of combinations can be used to accommodate individual requirements. Because these instruments are connected by flexible wire leads they may be installed in different parts of the plant, widely separated from each other.



# 8-INCH ROUND CHARTS FOR RECORDING ELECTRIC TACHOMETER

MODELS 1837 and 1840

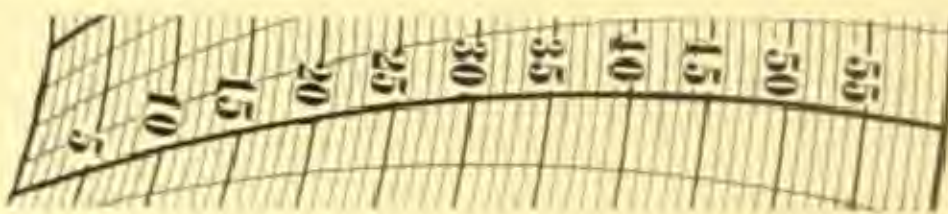
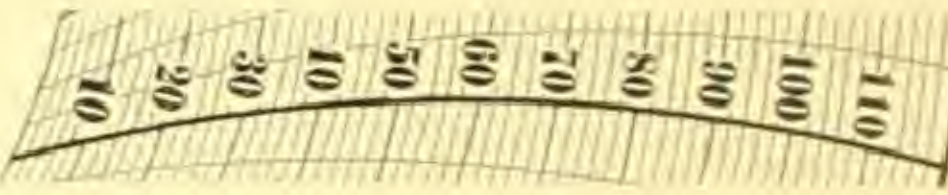

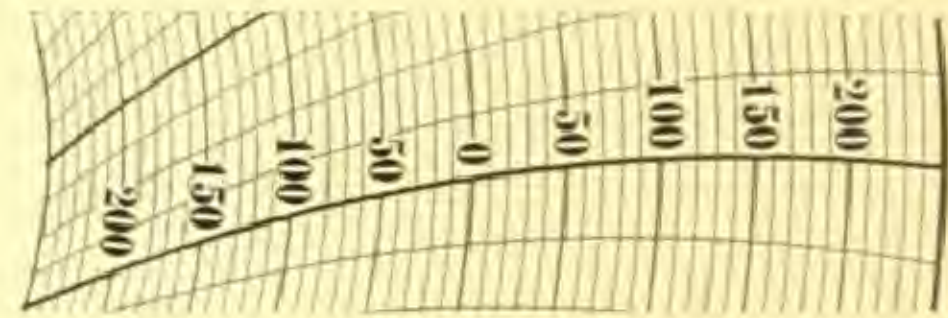
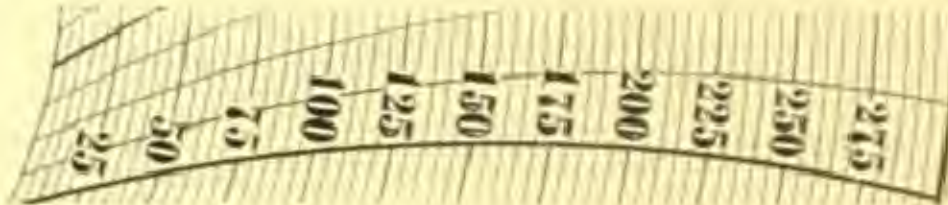
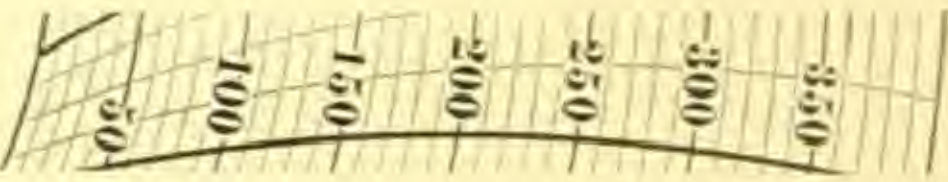
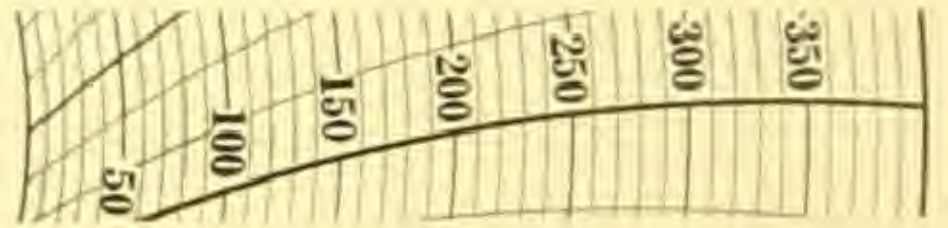
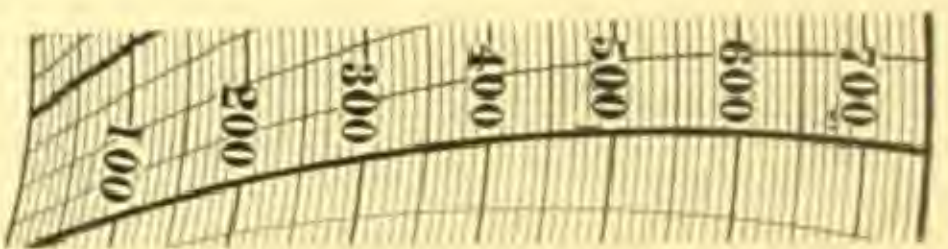
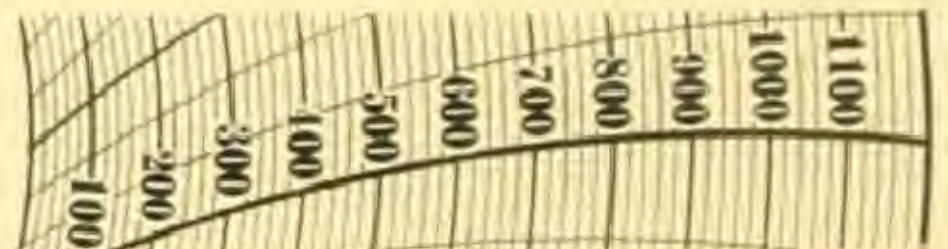
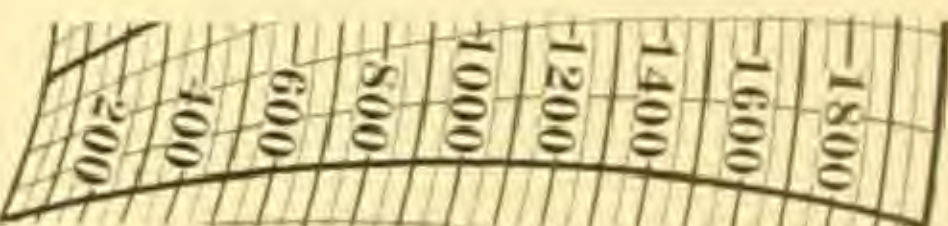
Chart No.	Total Range REVOLUTIONS PER MINUTE	One REVOLUTION OF CHART	Specimen Section of Chart
4209	0-60	24-hour	
4225	0-120	24-hour	
4202	200-0-200	12-hour	
4221	250-0-250	24-hour	
4222	0-300	24-hour	
4224	0-400	24-hour	
4226	0-400	12-hour	
4216	0-750	24-hour	
4217	0-1200	6-hour	
4206	0-2000	24-hour	

Chart  
No.

4215

4201

4215

4223

4214

4220

Chart  
No.

84207

84210

84202

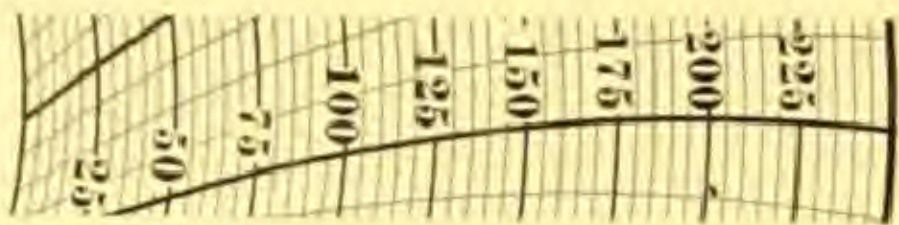
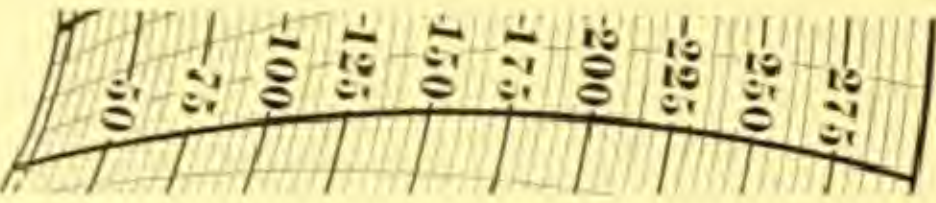
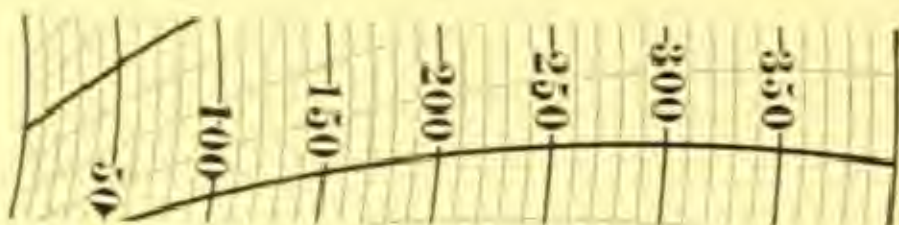
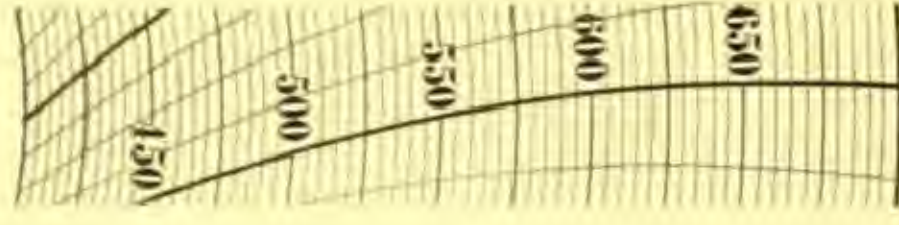
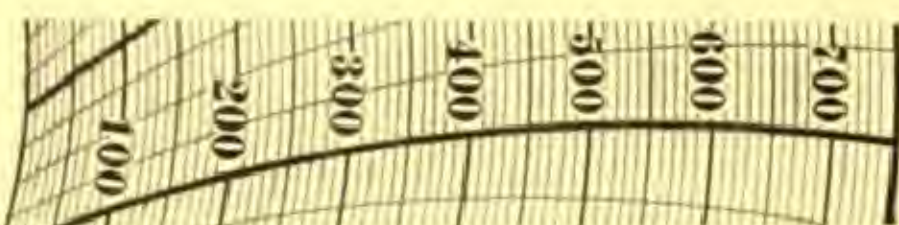
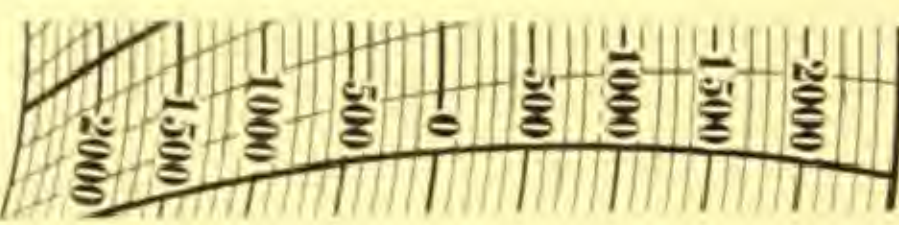
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## 8-INCH ROUND CHARTS FOR RECORDING ELECTRIC TACHOMETER

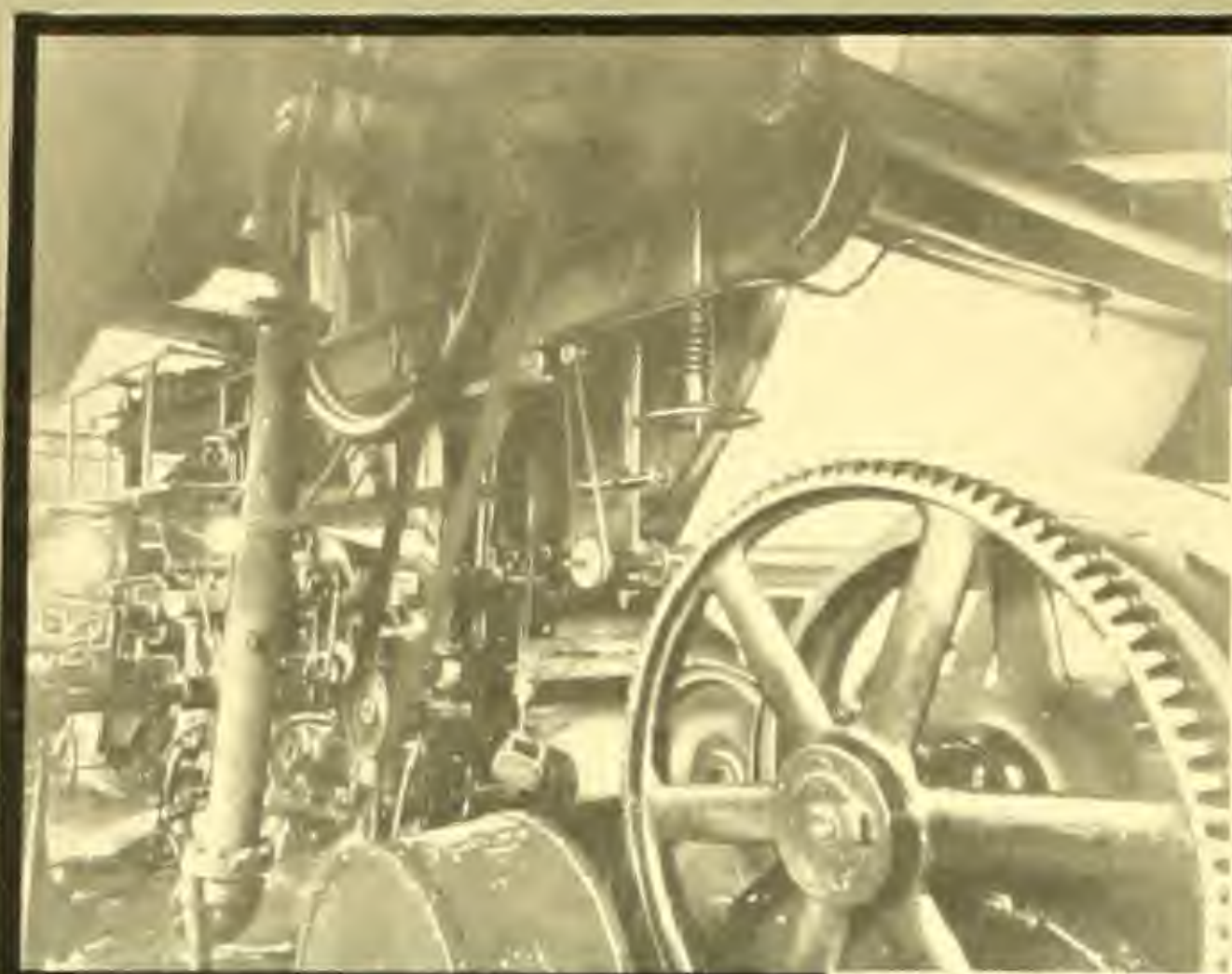
MODELS 1837 and 1840

Chart No.	Total Range FEET PER MINUTE	One REVOLUTION OF CHART	Specimen Section of Chart
4215	0-250	24-hour	
4201	20-300	24-hour	
4213	0-400	24-hour	
4223	400-700	24-hour	
4214	0-750	24-hour	
4220	2500-0-2500	24-hour	

## STRIP CHARTS FOR RECORDING ELECTRIC TACHOMETER MODEL 1825

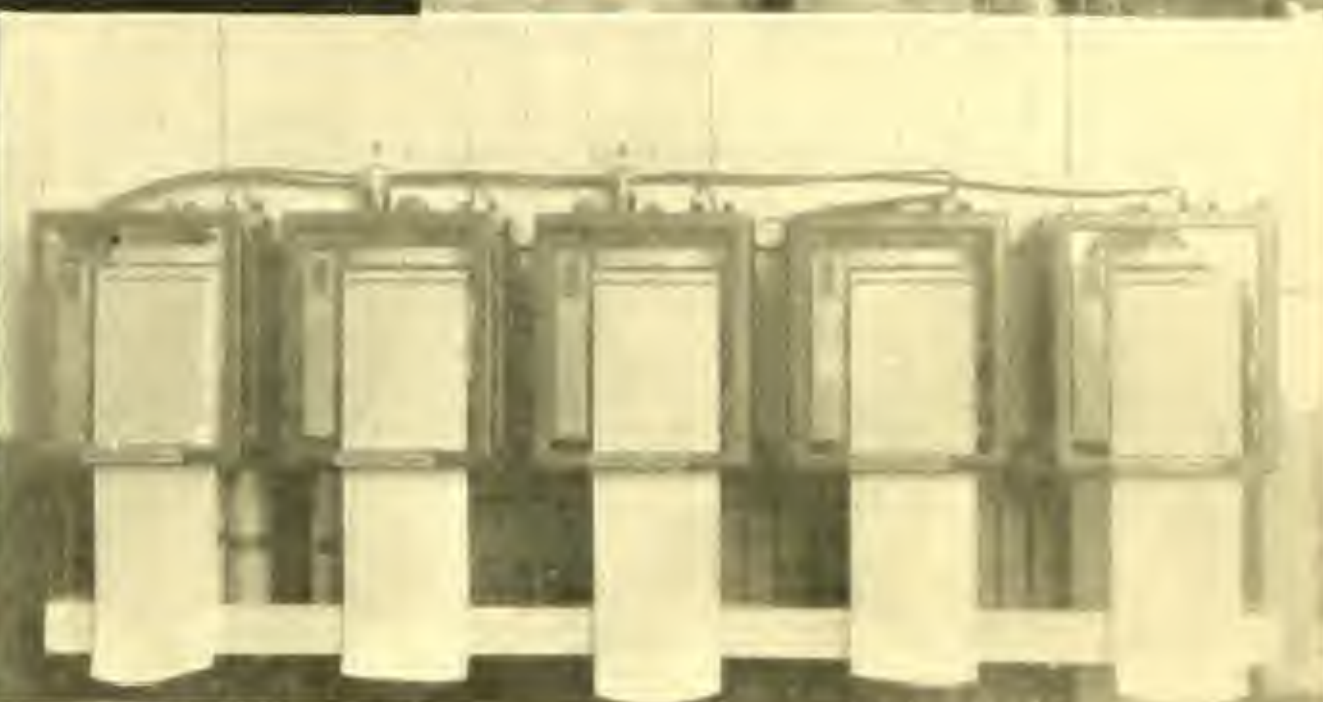
Chart No.	Total Range REVOLUTIONS PER MINUTE	Clock Speed	Chart No.	Total Range FEET PER MINUTE	Clock Speed
S4207	0-150	3"-per hour	S4201	0-200	3"-per hour
S4210	150-350	3"-per hour	S4200	0-300	3"-per hour
S4202	0-400	3"-per hour	S4204	0-400	3"-per hour
S4211	400-800	3"-per hour	S4203	200-500	1"-per hour
S4206	0-1000	1"-per hour	S4209	0-500	1"-per hour
			S4212	0-600	3"-per hour
			S4205	0-800	1"-per hour



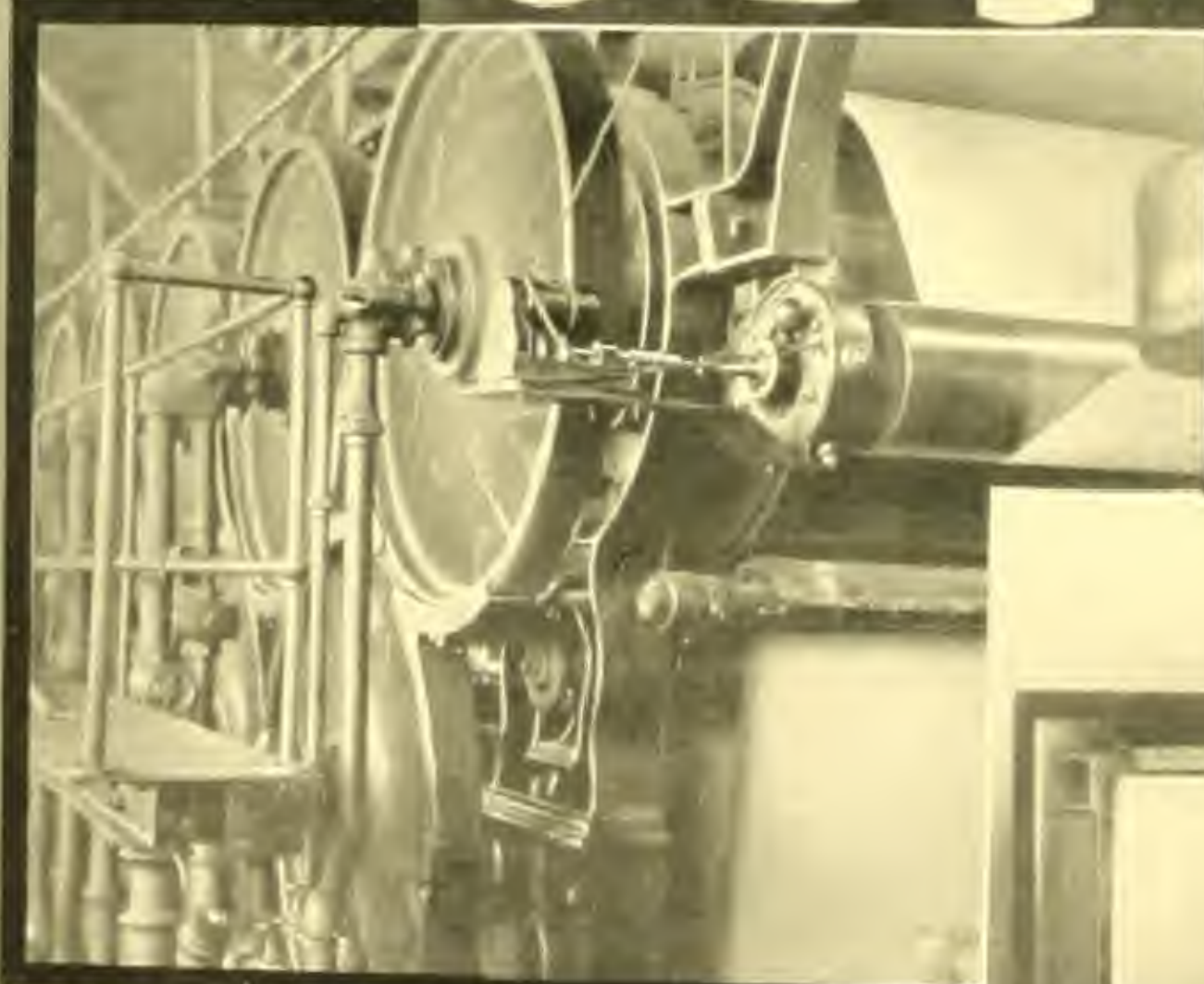


*Typical installations of  
Bristol's Tachometers in  
paper mills.*

*Installed on paper mach-  
ine the magneto (above)  
uses belt  
drive; sim-  
ilar equip-  
ment (below)  
is shown  
with uni-  
versal  
joint.*



*The Indi-  
cating  
Tacho-  
meter  
(above) is  
installed  
on wall  
near in-  
dividual  
machine*



*to guide the operator, the  
recording instruments are  
in the Superintendent's office*





## ACCURATE CHARTS NECESSARY

Every Recording Tachometer is calibrated to be used with the particular chart specified. This makes it necessary that every chart must be identical without even the slightest variation, in order to insure accuracy. For this reason, every attention is given to the finest details which make Bristol's charts absolutely accurate and reliable under all conditions.

Even the paper on which Bristol's charts are printed is made specially for the purpose. The charts are printed in our own plant from extremely accurate engravings, and under uniform humidity conditions.

The accuracy of Bristol's Recording Tachometers cannot be guaranteed unless genuine Bristol's Charts are used. To identify them, every round chart is printed on paper having water mark reading "Bristol's" and the name of The Bristol Company printed in the center; all strip charts have "The Bristol Company" printed on the side.

## CHART REPLACEMENTS

With every new round chart instrument a supply of one hundred charts is included. Additional replacements may be obtained at any time. When ordering specify chart number and kind of instrument.

For convenience, Bristol's Round Smoked (carbon coated) charts are packed in boxes using special separator discs and rings to prevent the sensitized surface from being rubbed off. This facilitates delivery, provides an inexpensive means of filing, and insures clean, unmutated charts.

New strip chart instruments are furnished with one ninety-foot chart roll. Additional supplies can be furnished as wanted.

## ADDITIONAL SUPPLIES

In addition to charts, the other supplies required are: ink for direct marking instruments; and fixative solution for smoked charts.



## SPECIAL INK

Each strip chart recording instrument is furnished with a two-ounce bottle of Bristol's Special Recording Instrument Ink. The ink is specially prepared for the purpose and is slow-drying so that one filling of the reservoir is sufficient for several days service under ordinary operating conditions. The standard color is black.



## FIXATIVE SOLUTION

After the smoked chart has been removed from the instrument it is dipped into a fixative solution thus making the record permanent.

With each new recording instrument using smoked charts a one-quart can of Fixative is included. Further supply may be had at any time.





## DETAILS FOR ORDERING BRISTOL'S TACHOMETERS

(This information will help to secure most suitable equipment  
for your particular requirements.)

1. INDICATING OR RECORDING.
2. MODEL NUMBER.
3. FINISH OF CASE (If other than standard.)
4. CONNECTIONS (Front or Back connections.)
  - (a) Recording Pneumatic Tachometer Model 811, are standard with Front connection.
  - (b) Indicating Electric Tachometer Model 18-410, standard with Front Connection.
 

"	"	"	"	18-452,	"	"	Back	"
"	"	"	"	18-422	"	"	Front	"
"	"	"	"	18-273	"	"	Back	"
  - (c) Round Chart Recording Electric Tachometer Model No. 1837 are standard with top-connection for mounting on wall or switchboard. Can also be furnished top-back connection for switchboard use.
  - (d) Strip Chart Recording Electric Tachometer Model 1825 are standard with top-connection, but can be furnished back connected when concealed wiring is desired for switchboard mounting.
5. RANGE
  - (a) Maximum Revolutions per minute or Linear Speed, required to be measured.
  - (b) Average Working Revolutions or Speed.
  - (c) Minimum Revolutions or Speed of which a clear record is desired.
6. SCALE (For Indicating Tachometer.)
 

The Scales for Indicating Tachometers are hand drawn to take care of Individual installations and it is necessary to have the complete information under item No. 5.
7. CHART (For Recording Tachometer.)
 

Specify chart by number if listed. The charts most often used are listed in this bulletin. If they do not fully meet your requirements be sure to give details as per items Nos. 5 and 8.
8. CLOCK OR REVOLUTION OF CHART
 

Round Chart—24-hour or 7-day are standard.  
Strip Chart—Clock speeds 1-inch and 3-inches per hour are standard.
9. FLEXIBLE CONNECTION (For Pneumatic Tachometers.)
 

Length of Capillary Connecting Tube necessary between Tachometer Stand and Recording Instrument. 25-feet is standard; longer lengths furnished as required.

(For Electric Tachometer)

Length of Duplex copper lead between Magneto and Tachometer Instrument. 15-feet is standard; longer lengths furnished as required.
10. TACHOMETER STAND (For Pneumatic Tachometer.)
 

In order to furnish a pulley with correct ratio it is necessary to know Size of Driving Shaft and R. P. M.

 Shown  
on Page

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## LIST PRICES

For Use in Connection with Catalog No. 1701

EFFECTIVE DECEMBER 1, 1926

### BRISTOL'S TACHOMETERS, RECORDING AND INDICATING

Shown on Page	MAGNETOS and DRIVES	List Prices
6	Magneto Model 44, FOR DIRECT DRIVE, complete with Universal Joint.....	\$ 75.00
5	Magneto Model 44, in Cast Iron Water-Tight Case, FOR DIRECT DRIVE, complete with Universal Joint and tapped for 1/2-inch Conduit connection.....	137.25
6	Magneto Model 44, with Speeding-Up-Stand, used where Driving Shaft speed is too low to permit direct connection of Magneto. Arranged FOR DIRECT DRIVE, complete with Universal Joint, Speed-Up Gear ratio 1:2 or 1:5 as required.....	135.00
7	Magneto Model 44, with Speed-Reducing-Stand, used where speed of magneto is in excess of 1000 R.P.M., in order to bring the operating speed of the magneto to or below this value. Arranged for DIRECT DRIVE, complete with Universal Joint, and ball bearing type Speed-Reducing-Stand, suitable for 2000 R.P.M. or over, all mounted on hard wood base.....	150.00
	Same as above except with plain bearing bevelled gear type Speed-Reducing-Stand, suitable for 2000 R.P.M. or under, all mounted on hard wood base.....	135.00
6	Magneto Model 44, FOR BELT DRIVE, complete with 2-inch Pulley.....	75.00
	With the above is furnished without additional charge, Canvas Web Belt, 3/4-inch wide, sufficient for 6-feet center of drive. Additional lengths furnished at, per yard.....	.11
	Solid Drive Pulley suitable for shafts 1 to 2-inches in diameter.....	6.00
	Size of Pulley 2 or 3-inches.....	6.75
	Size of Pulley 4 or 5-inches.....	7.50
	Size of Pulley 6-inches.....	7.00
	Split Drive Pulley.....	10.50
	Size 2 or 3-inches.....	11.50
	Size 4 or 5-inches.....	7.00
	Size 6-inches.....	10.50
6	Magneto Model 44, FOR GEAR DRIVE, complete with Pinion Gear, choice of 32, 48, 64, 80 or 96 teeth; for 2, 3, 4, 5, and 6-inch pitched diameters respectively.....	75.00
	Split Spur Drive Gears for 32, 48, 64, 80 or 96 teeth; having.....	7.00
	2 or 3-inch pitch diameters.....	10.50
	4 or 5-inch pitch diameters.....	11.50
	6-inch pitch diameters.....	7.00
6	Magneto Model 44, FOR SILENT CHAIN DRIVE, complete with 2 1/2-inch Sprocket.....	75.00
	Driving Sprocket and Silent Chain, prices quoted on request.....	
6	MAGNETO IN WATER PROOF BOX WITH ANEMOMETER VANE, prices quoted on request.....	

### RECORDING ELECTRIC TACHOMETER INSTRUMENTS

9	MODEL 1837 ROUND CHART TYPE Recording Electric Tachometer; using smoked (carbon coated) chart; Direct Marking Pointer; Clock for 24-hour, 12-hour revolutions, etc., as selected; all metal dust-proof case, finished in black enamel with nickel raised parts; arranged for Front or Back Connection as specified; complete with 15-feet No. 14 Duplex Rubber Covered Copper Wire, having suitable terminals; 100 Charts; Can of Fixative; Clock Key; Padlock and Key.....	146.00
	MODEL 1839, specifications same as for Model 1837 except, instrument is mounted in cast-iron Moisture-Proof Case, having plain black enamel finish.....	152.00
10	MODEL 1825, STRIP CHART TYPE, SINGLE RECORD Recording Tachometer; Direct Marking Ink Recording System; furnished with chart having standard scale range as selected; black enamel finish case; arranged for wall or switchboard mounting; complete with 15-feet No. 14 Duplex Rubber Covered Copper Wire, with suitable terminals; one 90-foot Chart Roll; Clock Key; Padlock and Key; Bottle of Special Recording Instrument Ink.....	225.00
11	MODEL 1825, STRIP CHART TYPE DUPLEX Recording Electric Tachometer; other specifications same as for Single Record Instrument.....	450.00
11	MODEL 1825, STRIP CHART TYPE MULTIPLE Recording Electric Tachometer; arranged for any number of records up to six; equipped with electric motor for vibrating penarm and selective switching.....	350.00

#### NOTE:

Zero center charts round or strip type.....	5.00
Partial or suppressed zero ranges less than 50%.....	5.00
Partial or suppressed zero ranges 50% and over.....	10.00



## INDICATING ELECTRIC TACHOMETER INSTRUMENTS

Shown on Page		List Prices
12	MODEL 18-252, ROUND TYPE Indicating Electric Tachometer; arranged for Back Connection only; complete with 15-feet of Duplex Rubber Covered Copper Wire and suitable terminals, . . . . .	\$37.25
12	MODEL 18-410, ROUND TYPE Indicating Electric Tachometer; specifications same as for Model 18-252 except, arranged for Front Connection only, . . . . .	60.00
12	MODEL 18-273, FAN SHAPED TYPE Indicating Electric Tachometer; arranged for Back Connection only; complete with 15-feet of Duplex Rubber Covered Copper Wire and suitable terminals, . . . . .	48.50
	MODEL 18-422, FAN SHAPED TYPE Indicating Electric Tachometer; specifications same as for Model 18-273 except, arranged for Front Connection only, . . . . .	75.00

## COMBINATION RECORDING and INDICATING ELECTRIC TACHOMETERS

- 13 RECORDING and INDICATING Electric Tachometer Instruments can be furnished to use in combination. Such combinations may include one Recorder and one Indicator; one Recorder and two Indicators; two Recorders and two or more Indicators; in fact, almost any combination desired can be arranged for. However, all instruments must be calibrated together.

Prices for combinations, add together prices of each individual instrument as quoted above.

## MISCELLANEOUS

DUPLEX WIRE LEAD (Extra Lengths) furnished as required, per foot, . . . . .	.05
-----------------------------------------------------------------------------	-----

## CHARTS

### ROUND CHARTS

Smoked (Carbon Coated), for use with Bristol's Recording Electric Tachometers, size 8-Inch Diameter, per 100	2.75
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### STRIP CHARTS

For use with Bristol's Electric Recording Tachometers, Direct Marking, per Roll 90-Feet long, . . . . .	1.10
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## INK

### BRISTOL'S SPECIAL RECORDING INSTRUMENT INK

For use with Bristol's Recording Tachometer. Strip Chart Model, Two-ounce Bottle, . . . . .	.45
Four-ounce Bottle, . . . . .	.65
Half-pint Bottle, . . . . .	1.10
Pint Bottle, . . . . .	1.90
Quart Bottle, . . . . .	3.30
Special large ink filler for Strip Chart Instruments, . . . . .	.30

## FIXATIVE

### FIXATIVE FOR SMOKED CHARTS

Fixative Solution, in combination can suitable for fixing 8-Inch Charts, per quart can, . . . . .	.80
---------------------------------------------------------------------------------------------------	-----

## CHART HOLDER

### CHART HOLDER FOR WALL OR SHELF USE

For 8-Inch Round Chart, . . . . .	2.20
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(When ordering Chart Holders, specify whether for wall or shelf use.)

ALL THE ABOVE PRICES ARE F. O. B., WATERBURY, CONN.



# 11. MAGNETO (For Electric Tachometers.)

(a) Model—Standard 44 or Water-Tight Case.

(b) Kind of Drive—Refer to pages 6 and 7 for complete data and specify which. If for Belt Drive—2" Pulley for 1" flat belt is furnished as standard on Magneto Shaft. If belt is to be furnished give distance in feet between center of driver and Magneto pulley. Refer to diagrams below and advise which of these meet your conditions.

# 12. WORKING CONDITIONS

Application —What is the particular application or type of machine to which connections will be made?

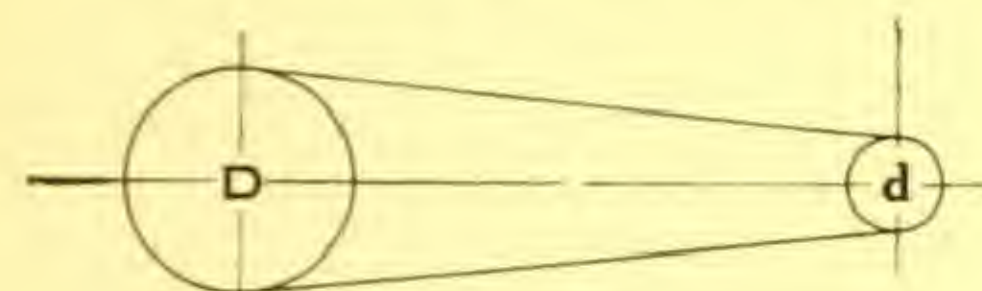
Atmospheric

Conditions —Will the instrument be installed where it is subjected to excessive dust, dirt, dampness or chemical fumes?

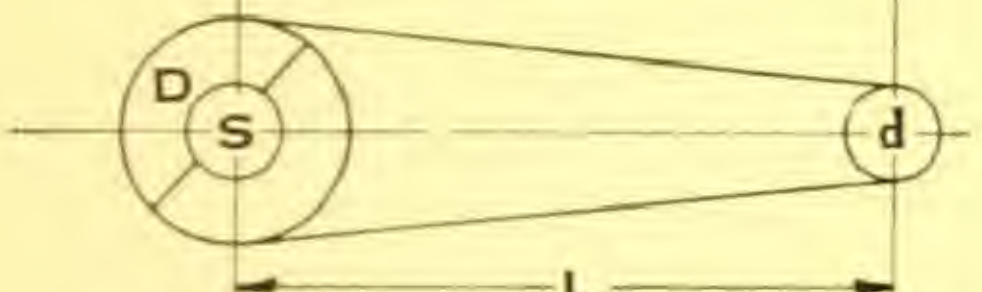
Any Unusual

Conditions —A rough sketch will help make clear any unusual conditions regarding your requirements.

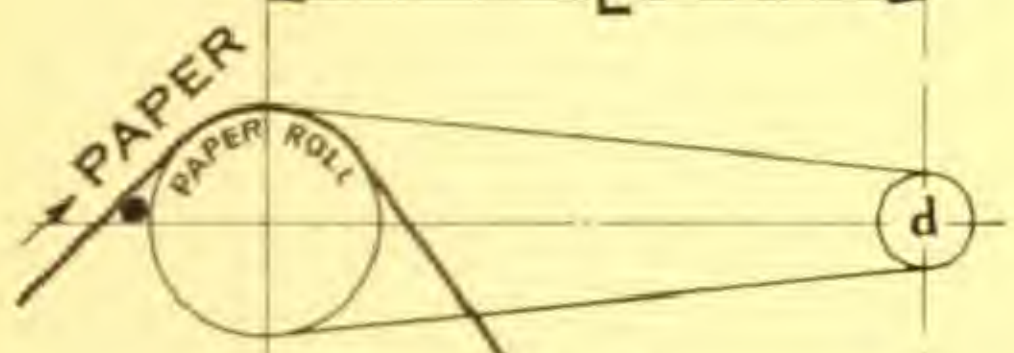
## DIAGRAMS SHOWING METHODS OF BELT DRIVE



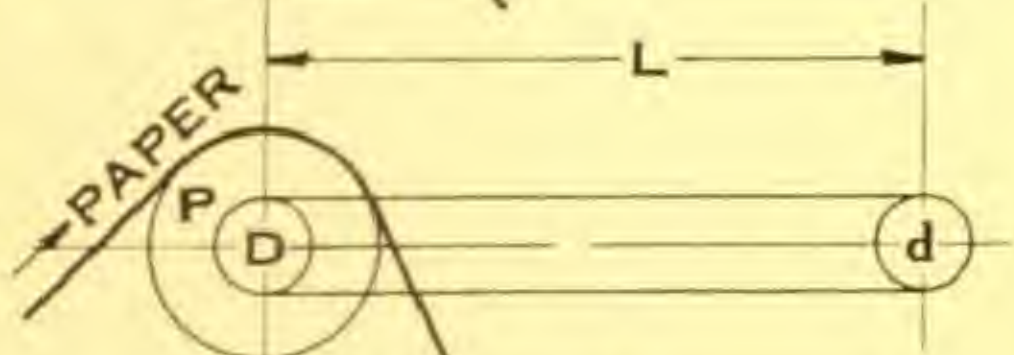
Shaft "D" itself is Driver.



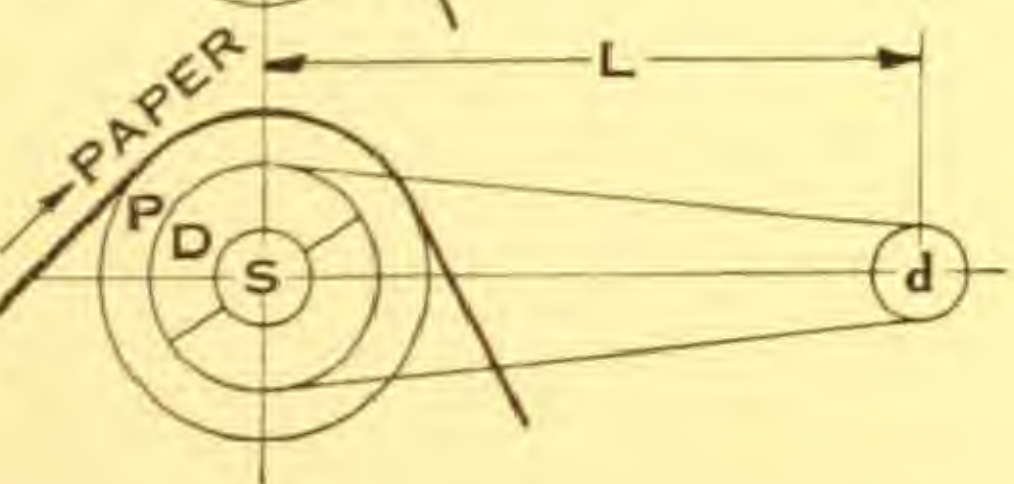
Pulley "D" mounted on shaft is Driver.



Paper Roll itself is Driver.

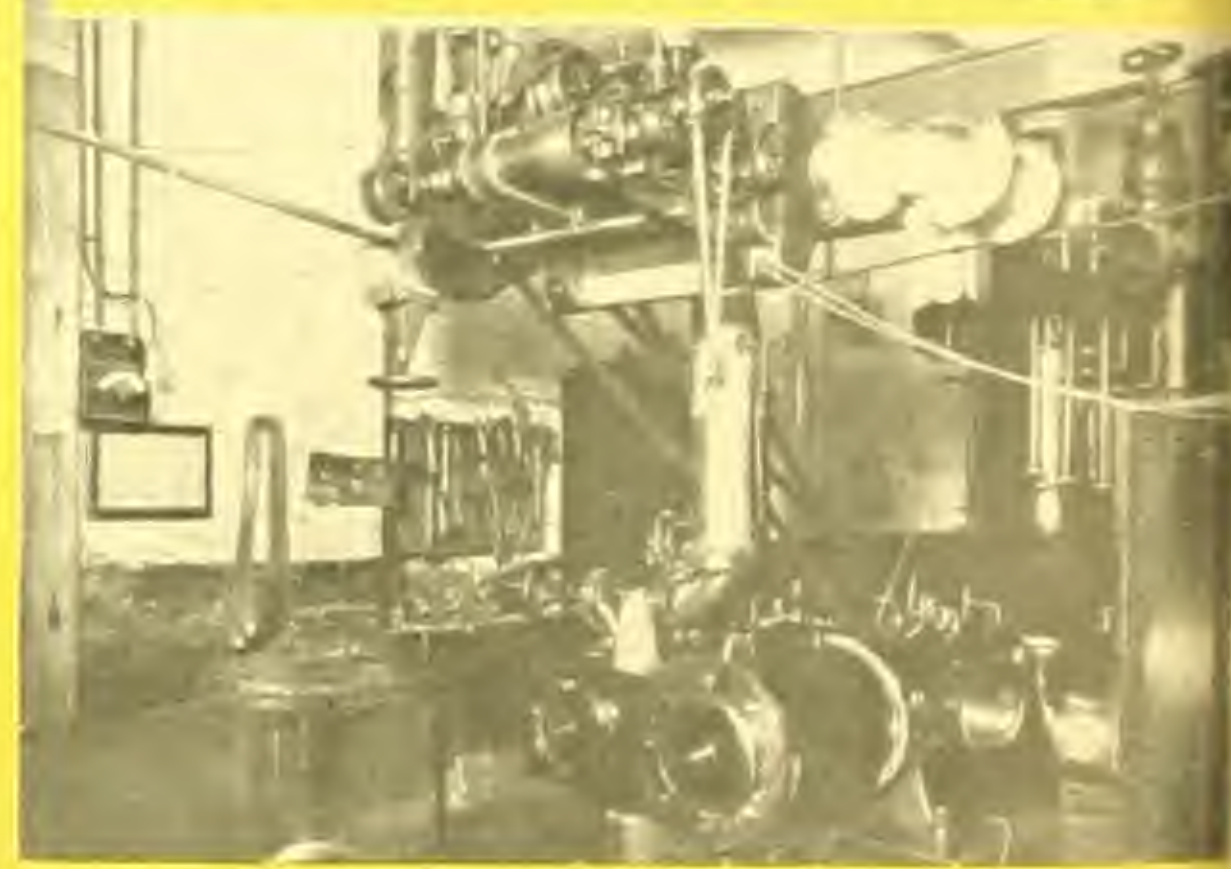
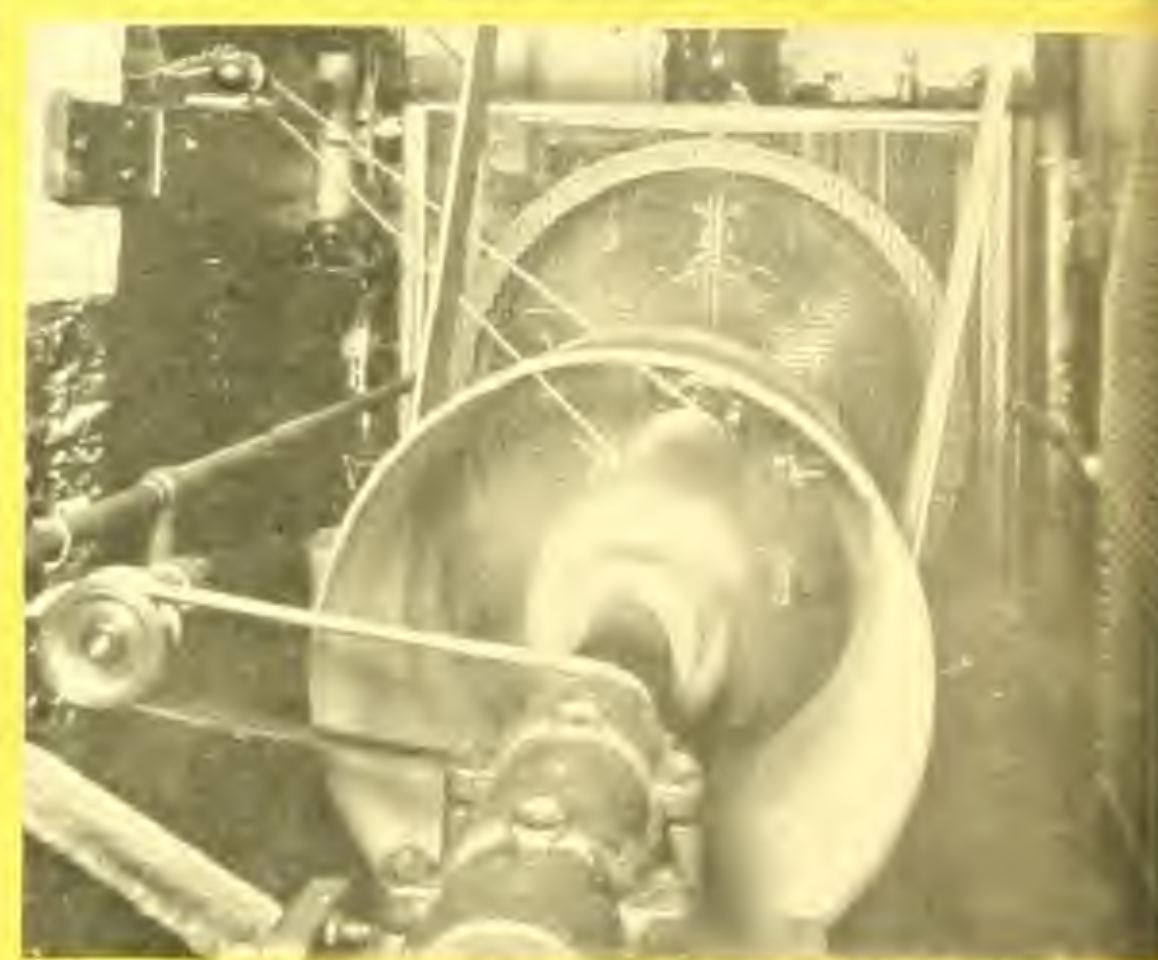
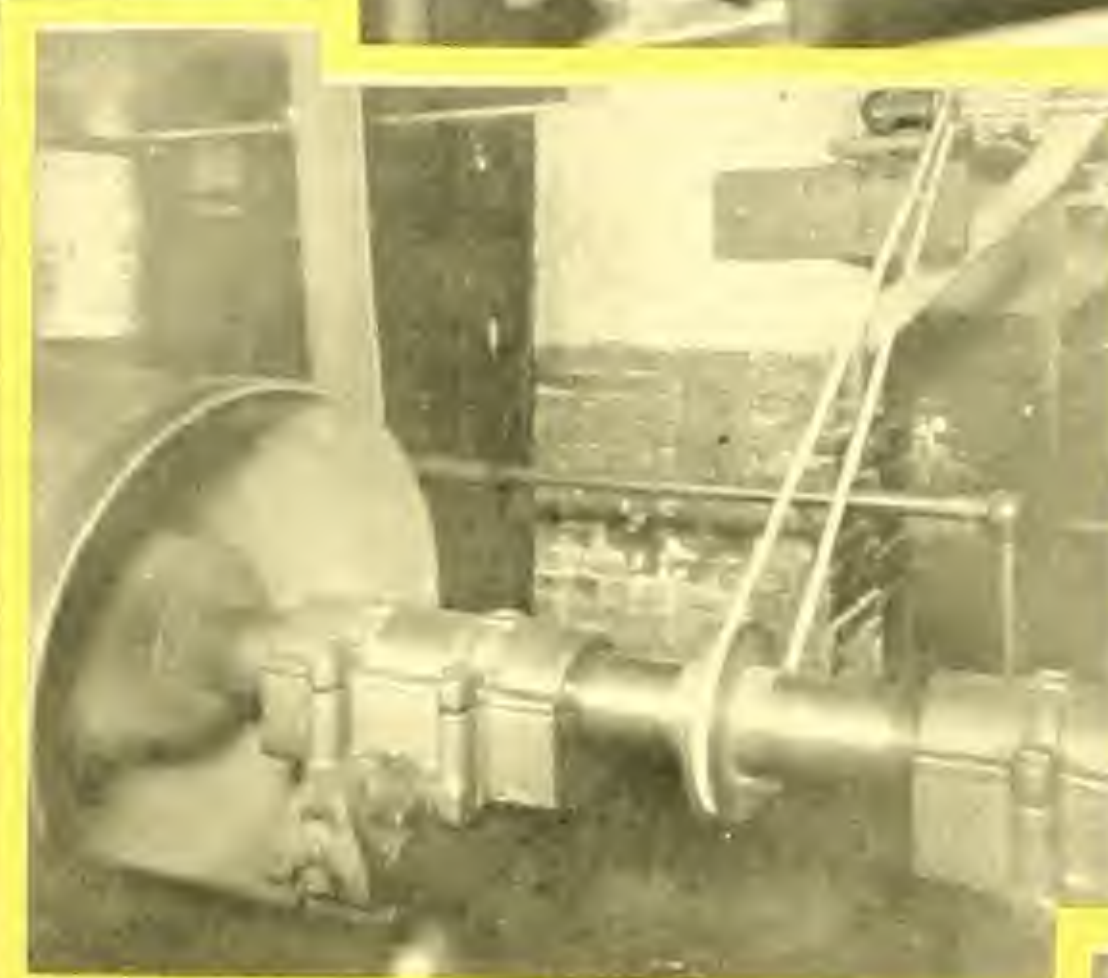
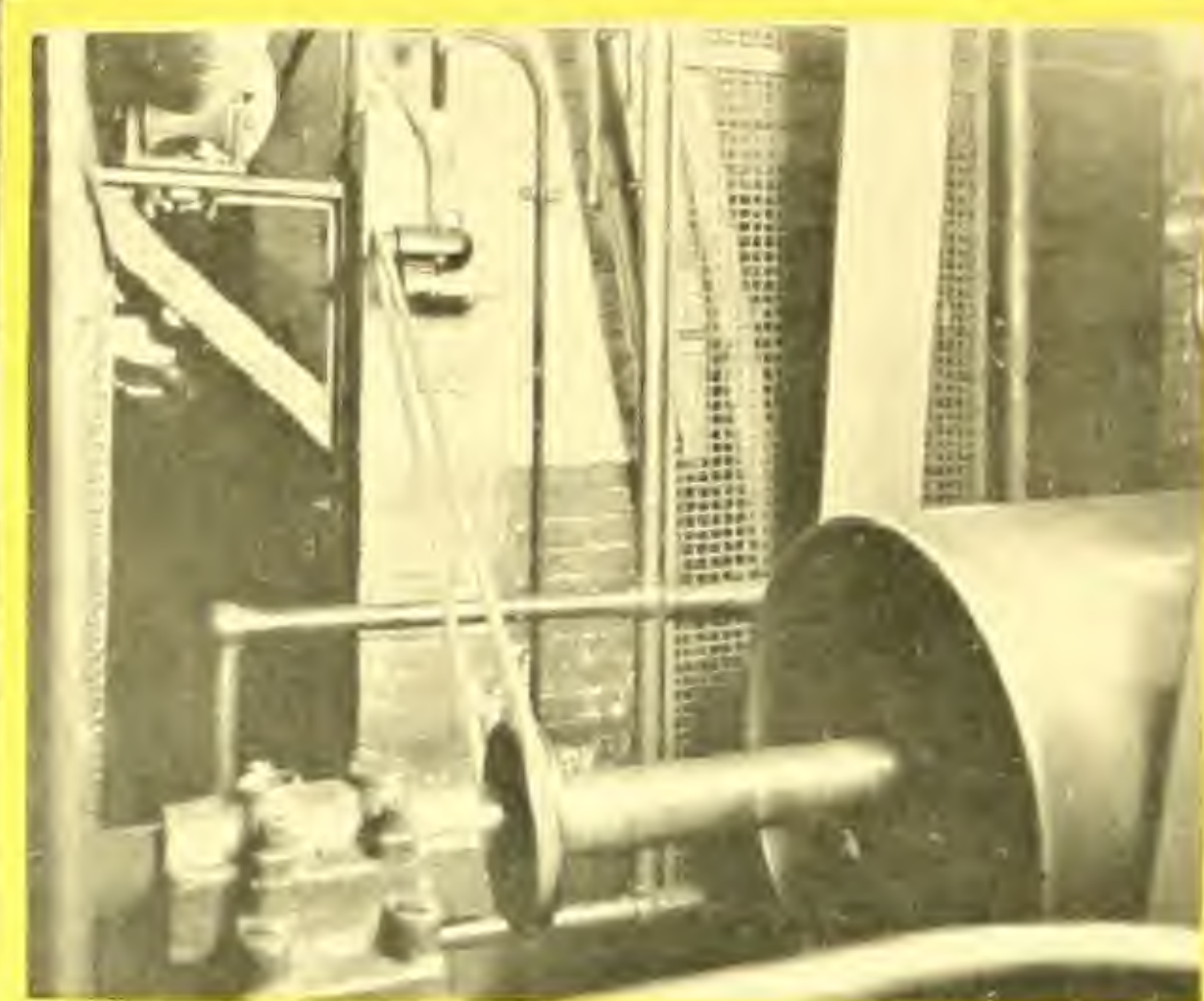
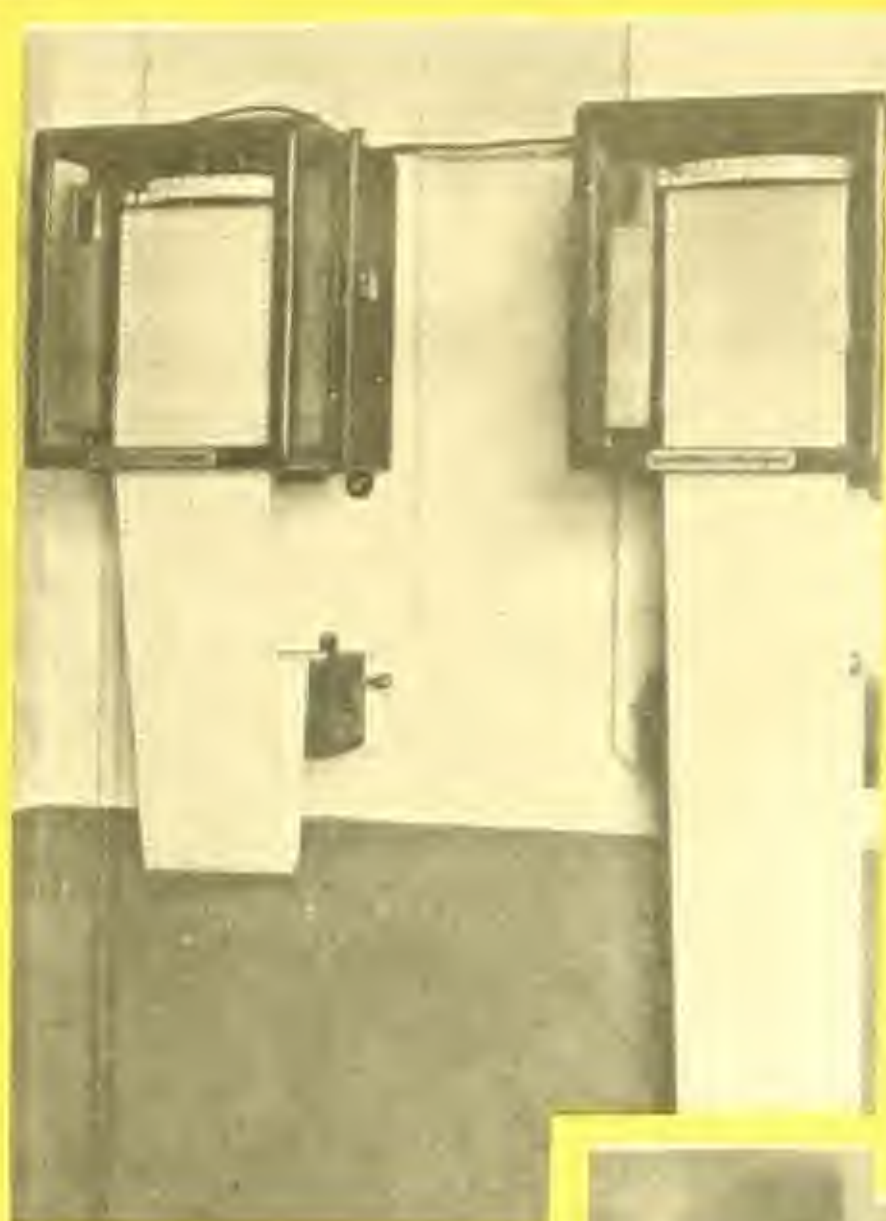


Shaft "D" of Paper Roll "P" is Driver.



Pulley "D" mounted on shaft of Paper Roll "P" is Driver.





## THE BRISTOL COMPANY

MAIN OFFICE AND FACTORY  
WATERBURY CONN., U.S.A.

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*Old South Bldg.*

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*Monadnock Block*

**ST. LOUIS**  
*Boatmen's Bank Bldg.*

**SAN FRANCISCO**  
*Rialto Bldg.*

**DENVER**  
*U.S. National Bank Bldg.*

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# THE BRISTOL COMPANY

WATERBURY, CONN., U. S. A.

BRANCH OFFICES

Boston New York Pittsburgh Detroit Chicago St. Louis San Francisco

BULLETIN

NO. 277

## BRISTOL COUNTERS

Automatically Count and Register Revolutions or Strokes. Accurately Measure Production of Machines. Save Waste of Time Spent in Counting by Hand or by Weight.



Fig. 693.

The Illustration, Fig. 693, Shows a No. 5, or Five-Figure Bristol Counter, which counts to 100,000.

Thousands of Bristol Counters are in use. They require a minimum of care and adjustment. They are made of iron and steel, each part being constructed of the metal best suited to its purpose. Dials are white; have  $\frac{1}{2}$ -inch figures plainly marked in black, making a large, clear, easily-read numeral. When the highest number is reached they repeat automatically. Their movements are noiseless, unfailing and correct.

### BRISTOL COUNTERS—Nos. 4, 5 and 6.

No.	Counts	Dimensions in Inches	Shipping Weight	List Price
4	10,000	$6\frac{3}{4} \times 2\frac{1}{2} \times 1\frac{3}{8}$	$3\frac{1}{2}$ Pounds	\$8.00
5	100,000	$8 \times 2\frac{1}{2} \times 1\frac{3}{8}$	$3\frac{3}{4}$ Pounds	10.00
6	1,000,000	$9\frac{1}{4} \times 2\frac{1}{2} \times 1\frac{3}{8}$	$4\frac{1}{2}$ Pounds	12.00
Can be furnished with a lock bar over the dial shafts. . . . . at extra				1.00

Number corresponds to number of figures.

Finish—Nickel-plated or black-enameled.

WRITE FOR DISCOUNT.



## BRISTOL COUNTERS

Especially valuable for use in connection with Blast Furnace Blowing Engines, Automatic Machines, Pumping Stations, Water Wheels, Printing Presses, Gas Machines, Textile Machinery, Railroad Signals, Water Weighing Machines, Cement Plants, Salt Factories, Copper Mines, Canning Factories, Cotton Mills, Paper and Bag Industry, and for use wherever there are mechanical operations to be counted.



Fig. 871.

The Illustration, Fig. 871, shows a No. 105, or Five-Figure Bristol Patent Set-Back Counter, which counts to 100,000

The principal feature of the new patent Bristol Set-Back Counter, illustrated in Fig. 871, is that all the figures can be set back to zero with one turn of the key applied on the slotted post. The key is shown on the right of illustration and the slotted post at the left. This feature is particularly valuable where resetting is necessary.

These set-back counters are listed under catalog numbers 104 and 105 on this page. They are made entirely of steel and brass. The cases are of polished brass and the pinions, ratchet wheel and lever of best steel. The dials are of brass, whitened, upon which the figures are plainly etched in black.

### BRISTOL PATENT SET-BACK COUNTERS—Nos. 104 and 105.

Patented January 23, 1912.

No.	Counts	Finish	Shipping Weight	List Price
104	10,000	Polished Brass	21 Ounces	\$11.00
105	100,000	Polished Brass	24 Ounces	13.00

WRITE FOR DISCOUNT.



**SHIPMAN'S**  
"Common Sense" Binder

Trade-Mark "Common Sense" Reg.  
Patented April 19, 1904

**No. 72068**

**Asa L. Shipman's Sons**  
**NEW YORK**

**MADE IN U.S.A.**



